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Bulletin

Michigan State University Agricultural
Experiment Station

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BULLETIN 264 **APRIL, 1911**

MICHIGAN
AGRICULTURAL COLLEGE
EXPERIMENT STATION

DAIRY HUSBANDRY DEPARTMENT

SECOND REPORT OF GRADE DAIRY HERD

BY

A. C. ANDERSON

EAST LANSING, MICHIGAN.
1911

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The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, East Lansing, Michigan.

MICHIGAN AGRICULTURAL EXPERIMENT STATION

Postoffice and Telegraph Address, - - - - - - - East Lansing, Mich.
Railroad and Express Address, - - - - - - - - - Lansing, Mich.

A DEPARTMENT OF THE STATE AGRICULTURAL COLLEGE, AND, WITH IT, CONTROLLED BY THE

INCORPORATED
STATE BOARD OF AGRICULTURE

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SUB-STATIONS

Chatham, Alger County, 160 acres deeded—Leo. M. Geismar in charge.
Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded—Frank A. Wilkin in charge.

UNIV. OF CALIFORNIA

GRADE DAIRY HERD.

The present Grade Dairy Herd which is maintained at the college was installed in the fall of 1904 by Director R. S. Shaw then Professor of Animal Husbandry. About a year later the writer was placed in charge of the work and is still continuing in that capacity.

In 1906 the first report was published in bulletin 238. As the edition of bulletin 238 is nearly exhausted, and as some of the data contained therein is necessary to a proper understanding of this report a portion of the material of the former report appears again in this.

In maintaining a grade dairy herd at this institution two chief ends are sought. First and foremost to show objectively how the common dairy stocks of this state can be improved as to quantity and quality of milk production by a rational and continued system of up-grading; and second to show the effect of careful feeding and management upon average, common, or even inferior dairy animals. While the stocking of farms with purebred dairy animals is desirable and strongly advised, it is generally recognized that the great mass of improvement among dairy cattle must come from intelligent up-grading. In selecting the foundation stock for a grade dairy herd attention was given first to the health and general physical characteristics of each individual selected. Care was also taken to secure animals which should be fairly uniform. To accomplish the desired ends with the material available in the Michigan markets it was thought best to purchase twenty Shorthorn grade cows. While none of these cows possessed a large percentage of Shorthorn blood, they all had enough to give the evenness and uniformity sought in the foundation herd. For breeding purposes the herd was divided into four groups or sub-herds of five animals each. One of these groups is being bred continuously to Jersey bulls, and the female progeny bred in the same line. Another of the groups is being bred continuously to Holstein bulls and the female progeny bred in the same line. The third group being bred in the same way to Guernsey bulls and the fourth to Shorthorn bulls.

The heifers which have come to maturity have been retained in the herd and at the present time have replaced all the original animals, but while the records of these grade heifers are being kept they form no part of this report.

The execution of the plans is requiring time and results are accumulating slowly, even more slowly than was at first anticipated. Some of the best animals in the herd left no female progeny, while two or three of the poorest left female progeny only. Along with the usual handicaps that every dairyman must endure came contagious abortion, a disease while less to be dreaded than tuberculosis still is capable of even more serious results in reducing the milk product and consequent profit as well as the number of progeny of a herd. In an attempt to stamp out this disease some drastic measures were adopted by the veterinarians in charge which not only failed to ac-

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and consequently it is only by chance that samples of such goods are obtained. If persons ordering goods in this way wish to have them inspected they will protect themselves and at the same time confer a favor on this department by notifying us, and upon the arrival of the goods an inspector will be sent to draw samples.

It is the desire of this department to make the inspection as complete as possible, and any information to further this end from dealer or consumer will be greatly appreciated. In all cases of failure to find a brand on the market, the analysis was made on the manufacturer's sample as indicated in the tables of analyses.

RESULTS OF INSPECTION.

A study of the tables of analyses shows that, of the 249 samples analyzed, representing 230 brands, 26 (10%) are below guarantee* in one or more constituents. Fourteen (5.6%) are below guarantee in nitrogen, 4 (1.6%) are below guarantee in available phosphoric acid, 2 (0.8%) are below guarantee in total phosphoric acid and 15 (6%) are below guarantee in potash. Six (2.4) are below guarantee in nitrogen and potash, 1 (0.5%) in nitrogen and available phosphoric acid.

While there are, as stated above, 34 samples falling below guarantee in one or more constituents, there are, however, only 3 (1.2%) that are more than 75 cents per ton below their guaranteed commercial value. That is, the shortage in one constituent is compensated by an excess of the guarantees in the other constituents. This is a very satisfactory showing.

SCHEDULE OF TRADE VALUES.

In accordance with the custom adopted and followed in previous years, the following schedule of prices for determining the commercial valuation of a fertilizer is published:

Nitrogen	16½c	per	pound
Potash soluble in water	4½c	"	"
Available phosphoric acid	5c	"	"
Total phosphoric acid in bone	4c	"	"
Insoluble phosphoric acid in fertilizers containing nitrogen	2c	"	"

In fertilizers containing no nitrogen no value is given to insoluble phosphoric acid. The valuation of a fertilizer is determined as follows: The percentage or pounds per hundred of each ingredient (nitrogen, available phosphoric acid, insoluble phosphoric acid and potash) is multiplied by 20, giving the number of pounds of each ingredient in a ton. These figures are then multiplied by their respective pound prices.

In the last column of the table of analyses headed "Valuation" is given the commercial valuation of the samples, as guaranteed and as found, based upon the prices quoted above.

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*A shortage of more than 0.10 per cent of nitrogen of more than 0.20 per cent of available phosphoric or potash is considered below guarantee.

In calculating the valuations we have assumed that the sources of the various ingredients have been the same in all cases, which of course is not true and also unfair to the manufacturer using only high grade goods, as it places the manufacturer who uses low grade materials, on the same level.

However, it should be clearly understood that the station valuation does not represent the proper retail price of the fertilizer at the point of consumption. It does represent the cash cost, at the larger fertilizer centers of the middle west, of an amount of nitrogen, available phosphoric acid and potash in unmixed, standard raw materials of good quality, corresponding with the amounts found in one ton of the fertilizer in question.

The difference between the selling price and valuation is represented by the cost of storing, grinding, bagging, hauling and freighting the goods, commissions to agents and dealers, bad debts, depreciation of machinery, interest on investment, etc. The percentage of difference between the valuation and selling price should not be more than 35 or 40.

Commercial valuations are useful, to show whether a fertilizer is worth its guaranteed money value. Purchasers will often find them useful in comparing the relative values of similar brands offered by different manufacturers.

The commercial valuation bears no relation to the agricultural value of a fertilizer, this is measured only by the increased yield of crop due to its use.

The mixing of the ingredients of which a fertilizer is composed does not increase their crop-producing power. They would produce the same effect if applied separately. The mixing simply lessens the labor of applying the materials.

Following are the names of the parties from whose stocks samples were drawn:

Adrian—Cutler, Dickerson & Co., W. R. Bradish, C. C. VanDoren, J. E. Bennet.

Alma— ———— Montigle.

Armada—C. I. Stump.

Azalia——Calvin Critchett, A. D. Master.

Battle Creek—Robert Binder, J. E. Moon, Caldwell & Armstrong.

Bankers—Wm. Cole.

Bay City—Bay County Hardware & Implement Co., Mohr Hardware Co., Jennison Hardware Co., Presley & Layer, R. C. Bialy, F. C. Goodeyne.

Belleville—Stephen Pearl.

Benton Harbor—B. M. Nowlen & Co., Cutler & Downing.

Birmingham—H. B. Parks.

Blissfield—M. Wolverton.

Bridgman—Bridgman Supply Co.

Brown City—John H. Linck.

Charlotte—R. J. Garber & Son, L. H. Shephard Milling Co.

Clayton—E. H. Hutchins.

Coldwater—A. J. Fiske, S. I. Treat & Son.
Coloma—J. T. Vanderveer, Wm. Stratton, Rube Hazen, E. M. Jackson.
Coopersville—Laug Bros., Reynolds Bros.
Covert—J. R. Spelman & Co.
Dearborn—C. Kandt.
Elm—I. Wilson, Shaw Bros.
Fremont—Dirk Kolk.
Galien—F. A. Koenigshof, Roberts Bros.
Grand Haven—Speidel & Swartz.
Grand Rapids—Jones Seed Co., Brown Seed Co., Grand Rapids Glue Co.
Harbert—Alexander Knaute.
Hillsdale—G. A. Aldrich & Son, C. H. Burlingame & Co., Wm. French, Newton Gregg, C. Dauber.
Holland—Mulder & Lugas, Klaas Dykhuis, John Meeswesner, Albert Alferink, Henry Siersma, H. W. Harrington, Groenewoud & Devries.
Hudson—W. H. Rhead, J. A. Dillon Jr., Atherton & Garling.
Ida—N. A. Weipert, Ida Hardware Co.
Ithaca—Isbell Seed Co., Jas. Boland Fert. Co., Watts, Morehouse Co.
Kalamazoo—M. DeWitte.
Lansing—Chas. G. Longstreet.
Lawton—Michigan Fruit Exchange.
Lennon—Ambert Weller.
Lenox—B. J. Reichman.
Lulu—Schultz Bros.
Manchester—Adam G, Houch.
Mason—J. E. Bullen, R. J. Osborne.
Maybee—M. L. Blanch, Fred Smith.
Memphis—Day & McCall.
Midland—Midland Milling Co., C. G. Olmstead.
Miland—Forsythe Co.
Monroe—Geckle & Martin.
Mt. Clemens—John N. Tucker.
Muskegon—John Stegink.
New Boston—R. E. Krause.
New Buffalo—Seigmund Bros.
Niles—E. E. Woodford.
Nunica—E. W. Hass, J. D. Pickett.
Owosso—A. B. Cook, Owosso Sugar Co., C. C. Wright, L. C. Hall.
Palmyra—P. P. Cook.
Petersburg—H. A. Logan & Son, T. Kohler.
Plymouth—C. F. Smith, G. C. Raviler, J. McLain, W. S. Burch, J. C. O'Bryan.
Quincy—Wm. A. Lott, J. N. Boyer.
Reading—Rigleman Bros., Arthur L. Lane, W. C. Hale, Walter Crawford.
Redford—C. A. Lasher, Westlake Bros.
Saginaw—Henry W. Carr Co.
Salzburg—Geo. L. Frank.
St. Louis—St. Louis Hardware Co.
South Haven—Merrifield & Brown.

Strasburg—C. W. Rau, J. F. Meyer.
Tecumseh—Slayton & Son.
Three Oaks—Chas. F. Bachman, J. W. Smith.
Waltz—Ludwig Krzszke, A. Ziegler.
Warren—F. A. Reddick, ——— Wolf.
Willis—George Freeman, R. J. M. King.
Willow—Jesse Butler.
Wyandotte—F. Bush, C. Koch.
Ypsilanti—Martin Dawson.
Zeeland—Isaac VanDyke, Henry Scholten, G. W. Hungerink, R. Knap.

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co., Detroit, Mich.		
2898	Banner Dissolved Bone..........................	Manufacturer's sample..	Claimed....
			Found......
2723	Beet Fertilizer..................................	W. Bay City..........	Claimed....
			Found......
2680	Double 10 Fertilizer..............................	Bankers..............	Claimed....
			Found......
2850	Fine Ground Bone................................	Adrian...............	Claimed....
			Found......
2851	High Grade Bone and Potash....................	Adrian...............	Claimed....
			Found......
2681	High Grade Garden and Vegetable Fertilizer........	Charlotte............	Claimed....
			Found......
2724	Maine Potato Formula...........................	Covert...............	Claimed....
			Found......
2682	M and I Special Manure.........................	Bankers..............	Claimed....
			Found......
2881	M and I Special Manure.........................	Holland..............	Claimed....
			Found......
2882	M and I Special Manure.........................	Adrian...............	Claimed....
			Found......
2952	M and I Special Manure.........................	Brown City...........	Claimed....
			Found......
2828	Michigan 10% Potash Manure.....................	Fremont..............	Claimed....
			Found......
2726	Muriate of Potash................................	Covert...............	Claimed....
			Found......
2727	Nitrate of Soda..................................	Covert...............	Claimed....
			Found......
2683	New York State Special..........................	Bankers..............	Claimed....
			Found......

1911, expressed in parts per one hundred.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	...... 38.00	...... 3.76	34 34.24	....	$34 00 34 24
1.23 1.39	11 11.75	...... 1.64	9 10.11	2 2.16	15 66 17 30
....	12 13.63	...... 1.93	10 11.70	10 10.37	19 00 21 03
2.47 2.89	20 21.32	....	....	....	24 15 26 60
....	12 14.40	...... 2.48	10 11.92	5 5.30	14 50 16.69
1.65 1.82	10 10.55	...... 1.11	8 9.44	5 5.51	18 75 20 85
1.65 1.76	10 10.30	...... 1.04	8 9.26	10 10.58	23 25 25 03
2.47 2.48	10 11.00	...... 1.11	8 9.89	6 6.12	22 35 25 12
2.47 2.50	10 11.80	...... 1.12	8 10.68	6 5.11	22 35 23 98
2.47 2.47	10 11.35	...... 1.20	8 10.15	6 6.63	22 35 24 75
2.47 2.54	10 10.37	...... 1.06	8 9.31	6 6.52	22 35 23 98
0.82 0.94	7 7.40	...... 0.65	5 6.75	10 10.23	17 51 19 32
....	....	....	....	49 50.15	44 10 45 14
15 15.66	....	....	....	....	49 50 51 68
0.82 0.93	10 10.63	...... 0.95	8 9.68	3 3.18	14 21 15 99

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—*Con.*		
2725	Special Pea and Truck Fertilizer	Holland	Claimed Found
2728	Bradley's Acid Phosphate	Covert	Claimed Found
2841	Bradley's Alkaline Bone and Potash	Elm	Claimed Found
2729	Bradley's B. D. Sea Fowl Guano	Covert	Claimed Found
2844	Bradley's Dissolved Bone and Potash	Monroe	Claimed Found
2860	Bradley's Niagara Phosphate	Lennox	Claimed Found
2899	Bradley's Soluble Dissolved Bone	Manufacturer's sample	Claimed Found
2900	Bradley's Special Potash Fertilizer	Manufacturer's sample	Claimed Found
2861	Crocker's Ammoniated Wheat and Corn Phosphate	Memphis	Claimed Found
2901	Crocker's Dissolved Bone and Potash	Manufacturer's sample	Claimed Found
2730	Crocker's General Crop Phosphate	W. Bay City	Claimed Found
2684	Crocker's New Rival Ammoniated Superphosphate	Bankers	Claimed Found
2685	Crocker's Universal Grain Grower	Charlotte	Claimed Found
2686	A-1 Potash Fertilizer	Reading	Claimed Found
2733	High Potash Phosphate	St. Louis	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available		
2.47 2.49	11 11.52	.... 1.19	9 10.33	2 2.35	$19 75 21 15
....	12 13.70	.... 2.41	10 11.29	....	10 00 11 29
....	12 13.05	.... 2.18	10 10.87	2 1.99	11 80 12 66
2.06 2.23	10 10.42	.... 1.13	8 9.29	1.50 1.76	16 95 18 68
1.03 1.02	10 10.83	.... 1.04	8 9.79	2 2.02	14 00 15 40
0.82 0.87	9 9.85	.... 0.92	7 8.93	1 1.17	11 41 13 22
....	16 19.30	.... 1.16	14 18.14	....	14 00 18 14
0.82 1.00	10 10.60	.... 0.78	8 9.82	3 3.00	14 21 16 13
2.06 2.14	10 11.10	.... 1.38	8 9.72	1.50 1.72	16 95 18 89
....	12 12.90	.... 2.62	10 10.28	2 1.84	11 80 11 94
0.82 0.97	9 9.52	.... 0.85	7 8.67	1 1.25	11 41 13 34
1.23 1.38	11 11.50	.... 1.54	9 9.96	2 2.21	15 66 18 12
0.82 1.21	10 11.45	.... 1.12	8 10.33	2 2.19	13 31 16 74
0.82 1.02	10 11.42	.... 1.16	8 10.26	3 3.11	14 21 16 89
....	12 13.27	.... 1.76	10 11.51	5 5.12	14 50 16 12

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—*Con.*		
2731	Homestead Best Potato Fertilizer	St. Louis	Claimed.... Found......
2687	Homestead Bone Black Fertilizer	Quincy	Claimed.... Found......
2732	Homestead High Grade Garden and Vegetable Fertilizer	Ithaca	Claimed.... Found......
2688	Homestead Pea and Truck Fertilizer	Quincy	Claimed.... Found......
2734	Homestead Special Beet Fertilizer	Holland	Claimed.... Found......
2689	Homestead Sugar Beet Fertilizer	Quincy	Claimed.... Found......
2735	Homestead 10% Potash Manure	Holland	Claimed.... Found......
2690	Homestead Ten—Ten Special Compound	Quincy	Claimed.... Found......
2736	Red Line Complete Manure	Holland	Claimed.... Found......
2902	Red Line Phosphate	Manufacturer's sample..	Claimed.... Found......
2842	Red Line Phosphate with Potash	Elm	Claimed.... Found......
2737	Wolverine Phosphate	Holland	Claimed.... Found......
2903	Niagara Dissolved Bone and Potash	Manufacturer's sample..	Claimed.... Found......
2738	Niagara Grain and Grass Grower	Salzburg	Claimed.... Found......
2904	Niagara Potato and Vegetable Fertilizer	Manufacturer's sample..	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.71	10 10.25	.... 0.94	8 9.31	10 10.13	$23 25 24 45
2.06 2.13	10 11.50	.... 1.16	8 10.34	1.50 1.91	16 95 19 55
1.65 1.73	10 10.17	.... 1.60	8 9.57	5 5.02	18 75 20 44
2.47 2.65	11 12.47	.... 1.12	9 11.35	2 2.56	19 75 22 84
1.65 2.06	10 10.12	.... 0.94	8 9.18	5 5.00	18 75 20 86
1.23 1.45	11 12.50	.... 1.67	9 10.83	2 2.34	15 66 18 39
0.82 1.04	7 6.87	.... 0.86	5 6.01	10 10.56	17 51 19 28
....	12 13.50	.... 1.84	10 11.66	10 10.23	19 00 20 87
0.82 0.94	9 9.65	.... 1.15	7 8.50	1 1.17	11 41 13 11
....	16 19.30	.... 3.06	14 16.24	....	14 00 16 24
....	12 13.86	.... 2.38	10 11.48	2 1.99	11 80 13 27
....	12 13.17	.... 2.32	10 10.85	....	10 00 10 85
....	12 12.85	.... 2.70	10 10.15	2 1.88	11 80 11 84
0.82 0.90	9 9.15	.... 1.02	7 8.13	1 1.10	11 41 12 50
2.06 2.26	10 10.35	.... 1.16	8 9.19	3 3.18	18 30 19 97

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—*Con.*		
2905	Niagara Wheat and Corn Producer..............	Manufacturer's sample..	Claimed.... Found......
2739	Horse Shoe Acidulated Bone and Potash...........	Holland..............	Claimed.... Found......
2843	Horse Shoe Animal Bone Manure...................	Wyandotte...........	Claimed.... Found......
2940	Horse Shoe Bone and Potash......................	Manufacturer's sample..	Claimed.... Found......
2740	Horse Shoe Corn and Wheat Grower...............	Bay City.............	Claimed.... Found......
2692	Horse Shoe Garden City Superphosphate..........	Benton Harbor........	Claimed.... Found......
2691	Horse Shoe High Grade Vegetable Fertilizer.........	Benton Harbor........	Claimed.... Found......
2741	Horse Shoe Potash Manure......................	Ithaca................	Claimed.... Found......
2742	Horse Shoe Quick Acting Phosphate..............	Holland..............	Claimed.... Found......
2693	Horse Shoe Special Onion and Vegetable Manure....	Mason................	Claimed.... Found......
2694	Horse Shoe Sugar Beet Fertilizer.................	Mason................	Claimed.... Found......
2906	Horse Shoe 10-5 Potash Manure..................	Manufacturer's sample..	Claimed.... Found......
2695	Horse Shoe 3-8-6 Fertilizer......................	Mason................	Claimed.... Found......
2743	Boar's Head Corn and Wheat Grower.............	Holland..............	Claimed.... Found......
2744	Boar's Head Faultless Grain Grower..............	Holland..............	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.23 1.34	11 11.75	.... 1.46	9 10.29	2 2.05	$15 66 17 14
0.82 0.89	12 13.97	.... 1.67	10 12.30	1 1.42	14 41 17 19
0.82 1.04	9 9.75	.... 1.14	7 8.61	1 1.16	11 41 13 54
....	12 13.65	.... 2.62	10 11.03	2 1.94	11 80 12 78
1.65 1.68	10 11.42	.... 1.22	8 10.20	2 2.29	16 05 18 29
2.06 2.15	10 11.27	.... 0.92	8 10.35	1.50 1.82	16 95 19 45
1.65 1.69	10 10.97	.... 0.81	8 10.16	5 5.29	18 75 20 82
0.82 0.93	10 10.90	.... 0.94	8 9.96	3 3.25	14 21 16 34
....	12 11.62	.... 0.78	10 10.84	....	10 00 10 84
0.82 1.02	7 7.40	.... 0.83	5 6.57	10 10.76	17 51 19 95
1.23 1.47	11 12.40	.... 1.78	9 10.62	2 2.41	15 66 18 35
....	12 13.45	.... 2.48	10 10.97	5 4.92	14 50 15 40
2.47 2.58	10 11.40	.... 1.59	8 9.81	6 6.77	22 35 25 05
1.65 1.71	10 10.65	.... 1.08	8 9.57	2 2.19	16 05 17 61
0.82 1.01	9 9.92	.... 1.02	7 8.90	1 1.87	11 41 14 32

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—*Con.*		
2745	Boar's Head High Grade Vegetable Fertilizer	Holland	Claimed Found
2907	Boar's Head Potash Phosphate Fertilizer	Manufacturer's sample	Claimed Found
2746	Boar's Head Soluble Phosphate	Holland	Claimed Found
2747	Boar's Head Sure Growth Potash Manure	Alma	Claimed Found
2748	Boar's Head Sugar Beet Grower	Alma	Claimed Found
2749	Boar's Head 10% Potash Composition	Zeeland	Claimed Found
2750	Boar's Head World of Good Superphosphate	Holland	Claimed Found
	The American Fertilizer Co., Chicago, Ill.		
2696	Union Brand Complete Crop Grower	Three Oaks	Claimed Found
2697	Union Brand Corn and General Crop Grower	Hudson	Claimed Found
2908	Union Brand Dissolved Bone and Potash	Manufacturer's sample	Claimed Found
2751	Union Brand Gardner's Favorite	Bay City	Claimed Found
2883	Union Brand Gardner's Favorite	Tecumseh	Claimed Found
2857	Union Brand High Grade Sugar Beet Grower	Owosso	Claimed Found
2862	Union Brand King's Favorite	Ypsilanti	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 2.04	10 10.40	.... 1.23	8 9.17	5 5.00	$18 75 20 89
....	12 13.15	.... 2.46	10 10.69	5 4.83	14 50 15 04
....	12 13.92	.... 1.73	10 12.19	....	10 00 12 19
0.82 0.95	10 10.50	.... 0.74	8 9.76	3 3.03	14 21 15 93
1.23 1.39	11 11.82	.... 1.60	9 10.22	2 2.09	15 66 17 33
0.82 0.97	7 7.41	.... 0.67	5 6.74	10 10.11	17 51 19 31
2.06 2.11	10 10.62	.... 0.94	8 9.68	1.50 1.66	16 95 18 51
1.65 1.88	.... 11.25	1.50 1.36	8 9.89	2 2.18	15 84 18 59
0.82 0.89	.... 10.25	1 0.82	8 9.43	4 4.46	14 71 16 71
0.41 0.64	.... 12.25	1 0.94	10 11.31	5 5.43	16 25 18 69
3.20 3.16	.... 11.65	2 0.84	9 10.81	10 9.29	29 36 29 92
3.20 3.07	.... 11.75	2 1.16	9 10.59	10 11.47	29 36 31 50
1.65 1.71	.... 10.10	1.50 1.86	8 8.24	5 6.23	18 54 20 23
0.82 1.01	.... 10.70	1 1.64	8 9.06	3 3.18	13 81 15 91

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Fertilizer Co.—*Con.*		
2698	Union Brand Onion, Potato and Vegetable Grower...	Hudson..............	Claimed.... Found......
2849	Union Brand Pure Bone Meal and Potash...........	Tecumseh.............	Claimed.... Found......
	Armour Fertilizer Works, Chicago, Ill.		
2699	All Soluble..	Galien................	Claimed.... Found......
2909	Ammoniated Bone with Potash.....................	Manufacturer's sample..	Claimed.... Found......
2753	Armour's Bone Meal............................	Saginaw...............	Claimed.... Found......
2856	Armour's Standard..............................	Owosso................	Claimed.... Found......
2752	Banner Brand..................................	Saginaw...............	Claimed.... Found......
2884	Banner Brand..................................	Nunica................	Claimed.... Found......
2885	Banner Brand..................................	Midland...............	Claimed.... Found......
2700	Bone, Blood and Potash.........................	Coloma................	Claimed.... Found......
2893	Bone, Blood and Potash.........................	Saginaw...............	Claimed.... Found......
2894	Bone, Blood and Potash.........................	W. Bay City..........	Claimed.... Found......
2701	Crop Grower....................................	Bridgeman............	Claimed.... Found......
2754	Fruit and Root Crop Special......................	Midland...............	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.68	.... 10.85	1.50 1.51	8 9.34	7 7.96	$20 34 22 64
0.82 1.10	20 20.37	....	....	3 3.01	21 41 22 64
2.88 2.97	.... 9.12	0.50 0.67	8 8.45	4 4.00	21 30 22 12
2.47 2.53	.... 7.50	0.50 0.62	6 6.88	2 2.26	16 15 17 50
1.65 2.09	27 25.30	....	....	....	27 04 27 14
0.82 1.58	.... 11.52	0.50 1.77	8 9.75	3 3.10	13 61 18 46
....	.... 11.17	0.50 0.63	10 10.54	8 8.39	17 20 18 09
....	.... 11.15	0.50 0.25	10 10.90	8 8.08	17 20 18 17
....	.... 11.55	0.50 0.33	10 11.22	8 6.79	17 20 17 33
4.11 4.18	.... 11.78	0.50 3.01	8 8.77	7 7.85	28 06 30.83
4.11 4.27	.... 11.85	0.50 3.48	8 8.37	7 8.37	28 06 31.38
4.11 4.09	.... 12.04	0.50 3.04	8 9.00	7 8.38	28 06 31 25
1.21 1.26	.... 10.47	0.50 1.78	8 8.69	2 2.14	13 99 15 49
1.65 1.66	.... 9.75	0.50 1.17	8 8.58	5 5.14	18 14 19 16

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Armour Fertilizer Works.—*Con.*		
2755	Grain Grower	Saginaw	Claimed.... Found......
2702	High Grade Potato	Coloma	Claimed.... Found......
2863	Mixed Bone and Potash	Redford	Claimed.... Found......
2910	1-5-10 Fertilizer	Manufacturer's sample..	Claimed.... Found......
2756	Phosphate and Potash	Saginaw	Claimed.... Found......
2831	Soluble Phosphate and Potash	Coopersville	Claimed.... Found......
2911	Star Phosphate	Manufacturer's sample..	Claimed.... Found......
2757	Sugar Beet Special	W. Bay City	Claimed.... Found......
2703	Wheat, Corn and Oats Special	Battle Creek	Claimed.... Found......
	Bash Fertilizer Co., Fort Wayne, Ind.		
2704	Bashumus Big Crop Producer	Quincy	Claimed.... Found......
2758	Bashumus Big Truck Grower	Lansing	Claimed.... Found......
*2912	Bashumus Corn and Wheat Grower		Claimed.... Found......
2759	Bashumus Corn Special	Lansing	Claimed.... Found......
2760	Bashumus Garden Special	Lansing	Claimed.... Found......

*No sample of this brand was received at the station.

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.70	.... 9.72	0.50 0.86	8 8.86	2 2.08	$15 44 16 68
1.65 1.68	.... 10.35	0.50 1.14	8 9.21	10 10.78	22 64 24 91
0.82 0.84	18 19.90	....	....	4 4.33	20 71 22 59
0.82 0.76	.... 6.50	0.50 0.80	5 5.70	10 10.51	16 91 17 99
....	.... 11.05	0.50 0.20	10 10.85	2 2.70	11 80 13 28
....	.... 11.50	0.50 0.45	10 11.05	4 4.03	13 60 14 68
....	.... 15.50	0.50 0.22	14 15.28	....	14 00 15 28
0.82 1.07	.... 10.00	0.50 0.71	8 9.29	4 3.95	14 51 16 66
0.82 1.01	.... 8.77	0.50 1.14	7 7.63	1 1.11	10 81 12 42
1.60 0.97	.... 9.37	1 0.83	8 8.54	2 1.73	15 48 13 63
1 0.84	.... 10.11	1 0.26	8 9.85	8 7.39	18 90 19 37
2	....	1	5	2	13 80 ....
1.20 0.92	.... 10.11	1 0.25	8 9.86	4 4.08	15 96 16 67
1 0.87	.... 9.36	1 0.33	8 9.03	10 9.64	20 70 20 71

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Robert Binder Est., Battle Creek, Mich.		
2707	Blood and Bone..................................	Battle Creek..............	Claimed.... Found......
	The James Boland Rendering & Fertilizer Co., Jackson, Mich.		
2705	Blackman General Crop Fertilizer.................	Jackson..............	Claimed.... Found......
2706	Blackman Sugar Beet, Onion and Potato...........	Jackson..............	Claimed.... Found......
	E. Burton, St. Joseph, Mich.		
2714	Meat and Bone Phosphate.........................	St. Joseph............	Claimed.... Found......
	The Buffalo Fertilizer Co., Buffalo, N. Y.		
2913	Bone Meal.......................................	Manufacturer's sample..	Claimed.... Found......
2761	Celery and Potato Special.......................	Hartford............	Claimed.... Found......
2914	Dissolved Phosphate.............................	Manufacturer's sample..	Claimed.... Found......
2708	Extra Phosphate and Potash......................	Coldwater............	Claimed.... Found......
2709	Farmer's Choice.................................	Reading..............	Claimed.... Found......
2915	Garden Truck....................................	Manufacturer's sample..	Claimed.... Found......
2710	General Crop....................................	Coldwater............	Claimed.... Found......
2711	General Favorite................................	Coldwater............	Claimed.... Found......
2832	Ohio and Michigan Special.......................	Coopersville...........	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
5.25 5.90	13.17 15.45	....	....	....	$27 86 31 85
1.25 2.99	.... 14.51	.... 6.90	7 7.61	1.25 1.25	12 26 22 36
2.50 2.58	.... 14.16	.... 5.94	10 8.22	3 3.00	$20 95 21 81
4 3.62	.... 15.86	.... 5.22	15 10.64	0.36 0.24	28 52 24 86
2.90 2.86	22 25.30	....	....	....	27 17 29 06
1.60 2.03	.... 9.75	1 1.02	8 8.73	10 10.05	22 68 24 90
....	.... 17.90	1 1.16	14 16.74	....	14 00 16 74
....	.... 12.92	1 0.82	10 12.10	8 8.15	17 20 19 44
0.80 1.33	.... 10.32	1 1.73	8 8.59	5 5.55	15 54 18 67
3.30 3.29	.... 9.85	1 0.44	8 9.41	7 9.44	25 59 28 95
....	.... 10.65	1 0.86	9 9.79	3 2.93	11 70 12 43
1.20 1.56	.... 10.50	1 1.59	8 8.91	2.50 3.70	14 61 18 03
0.80 1.27	.... 12.32	1 1.85	10 10.47	1 1.83	13 94 17 05

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	The Buffalo Fertilizer Co.—*Con.*		
2712	York State Special	Coldwater	Claimed Found
2939	York State Special	Muskegon	Claimed Found
2839	Nitrate of Soda	Plymouth	Claimed Found
2916	Gleaner Acid Phosphate	Manufacturer's sample	Claimed Found
2713	Gleaner Favorite	Mason	Claimed Found
2852	Gleaner General Grower	Wayne	Claimed Found
2853	Gleaner Phosphate and Potash	Wayne	Claimed Found
2854	Gleaner Special	Wayne	Claimed Found
	Chicago Raw Products Co., Chicago, Ill.		
2948	Consumers Special Acid Phosphate	Manufacturer's sample	Claimed Found
2953	Consumers Special Corn and Oats Fertilizer	Manufacturer's sample	Claimed Found
2949	Consumers Special Corn and Wheat Grower	Manufacturer's sample	Claimed Found
2947	Consumers Special High Grade Wheat Grower	Manufacturer's sample	Claimed Found
2950	Consumers Special Onion and Vegetable Grower	Manufacturer's sample	Claimed Found
	Cincinnati Phosphate Co., Cincinnati, Ohio.		
2869	Black Soil Fertilizer	Willis	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.60 1.88	.... 10.82	1 0.85	9 9.97	5 7.08	$19 18 21 23
1.60 1.86	.... 10.60	1 1.12	9 9.48	5 6.04	19 18 21 51
15 15.68	....	....	....	....	49 50 51 74
....	.... 17.90	1 1.32	14 16.58	....	14 00 16 58
1.64 1.97	.... 9.75	1 1.17	8 8.58	4 4.59	17 41 19 68
0.82 1.08	.... 12.20	1 1.80	10 10.40	1 1.39	14 01 15 94
....	.... 11.30	1 1.16	10 10.14	2 2.29	11 80 12 20
0.82 0.91	.... 9.50	1 1.20	8 8.30	4 4.55	14 71 15 88
....	.... 17.40	1 0.83	14 16.57	....	14 00 16 57
....	.... 12.75	1 1.17	10 11.58	2 3.23	11 80 14 49
0.82 1.12	.... 11.35	1 1.81	8 9.54	4 4.93	14 31 18 40
....	.... 11.52	1 0.80	10 10.72	5 6.48	14 50 16 55
....	.... 11.42	1 0.86	10 10.56	10 10.90	19 00 20 37
....	.... 10.55	1 0.74	8 9.81	8 7.44	15 20 16 51

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Cincinnati Phosphate Co.—*Con.*		
2917	Bone and Phosphate Mixture Wheat Special........	Manufacturer's sample..	Claimed.... Found......
2918	Dissolved Phosphate and Potash	Manufacturer's sample..	Claimed.... Found......
2762	Grain and Grass Grower...........................	Holland..............	Claimed.... Found......
2763	Tobacco, Potato and Beet Grower..................	Holland..............	Claimed.... Found......
2764	Truck and Tobacco Fertilizer.....................	Holland..............	Claimed.... Found......
2886	Truck and Tobacco Fertilizer.....................	Holland..............	Claimed.... Found......
2833	Wheat Grower.....................................	Coopersville..........	Claimed.... Found......
	Darling & Company, Chicago Ill.*		
2715	Big Potash Brand.................................	Coldwater............	Claimed.... Found......
2887	Big Potash Brand.................................	Ithaca................	Claimed.... Found......
2888	Big Potash Brand.................................	Elm..................	Claimed.... Found......
2716	Chicago Brand....................................	Coldwater............	Claimed.... Found......
2717	Farmer's Favorite Brand..........................	Coldwater............	Claimed.... Found......
2765	General Crop Brand...............................	Coldwater............	Claimed.... Found......
2840	Phosphate and Potash Brand.......................	Elm..................	Claimed.... Found......

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*After the manuscript for this bulletin had been sent to the printers, Darling & Co. licensed a new brand, "Eight Per Cent Phosphate." It is guaranteed to contain 8% available phosphoric acid. We found 9.33%.

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.60 2.02	.... 20.40	6 7.56	10 12.84	1 1.22	$18 58 23 63
....	.... 12.95	1 0.98	10 11.97	4 4.28	13 60 15 82
0.80 0.95	.... 9.32	1 0.49	8 8.83	2 2.05	12 84 14 02
0.80 0.97	.... 9.65	1 0.42	8 9.23	4 3.99	14 64 16 19
1.60 1.66	.... 7.10	1 0.58	6 6.52	6 5.92	17 08 17 56
1.60 1.59	.... 7.90	1 0.70	6 7.20	6 6.16	17 08 18 27
....	.... 13.82	1 1.21	12 12.61	....	12 00 12 61
1.24 1.25	.... 9.63	2 1.00	8 8.63	10 10.24	21 89 22 36
1.24 1.24	.... 11.77	2 1.90	8 9.87	10 10.26	21 89 23 95
1.24 1.17	.... 9.80	2 0.70	8 9.10	10 10.23	21 89 22 44
1.65 1.60	.... 11.47	2 2.79	8 8.68	2 2.11	16 05 16 98
2.47 2.57	.... 13.97	2 3.52	8 10.45	4 4.01	20 56 23 95
0.82 1.05	.... 10.67	2 0.75	8 9.92	6 6.70	16 91 19 72
....	.... 11.41	.... 1.68	10 9.73	2 2.15	11 80 11 67

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Darling & Company.—*Con.*		
2919	Pure Bone and Potash	Manufacturer's sample	Claimed Found
2920	Pure Ground Bone	Manufacturer's sample.	Claimed Found
2766	Sugar Beet and Root Grower Brand	Bay City	Claimed Found
2767	Sure Winner Brand	Hudson	Claimed Found
2921	Ten-Five Brand	Manufacturer's sample	Claimed Found
2768	Vegetable and Lawn Fertilizer	Bay City	Claimed Found
2896	Vegetable and Lawn Fertilizer	Midland	Claimed Found
	Farmers Fertilizer Co., Columbus, Ohio.		
2871	Farmers Acid Phosphate	Belleville	Claimed Found
2872	Bone Meal	Belleville	Claimed Found
2873	Nitrate of Soda	Belleville	Claimed Found
	German Kali Works, Baltimore, Md.		
2769	Kainit	Battle Creek	Claimed Found
2941	Muriate of Potash	Manufacturer's sample	Claimed Found
2834	Sulfate of Potash	Grand Rapids	Claimed Found
	Grand Rapids Glue Co., Grand Rapids, Mich.		
2879	Grand Rapids	Grand Rapids	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
2.14 2.22	20.15 23.30	....	....	6 6.50	$28 59 31 82
2.47 2.54	23 26.15	....	....	....	26 55 29 30
1.65 1.60	.... 10.32	2 1.39	8 8.93	5 5.14	18 75 19 41
0.82 0.78	.... 10.10	2 1.32	8 8.78	3 2.91	14 21 14 50
....	.... 11.25	.... 0.80	10 10.45	5 4.38	14 50 14 39
3.30 3.26	.... 11.97	2 1.45	8 10.52	7 7.48	25 99 28 59
3.30 3.38	.... 12.32	2 2.12	8 10.20	7 7.08	25 99 28 58
....	.... 18.90	0.50 1.14	14 17.76	....	14 00 17 76
1.64 1.47	20 19.65	....	....	....	21 41 20 57
15.50 15.53	....	....	....	....	51 15 51 25
....	....	....	....	12 12.13	10 80 10 92
....	....	....	....	50 50.05	45 00 45 05
....	....	....	....	48 49.33	43 20 44 40
2 2.48	.... 17.80	6 5.68	6 12.12	1 1.09	15 90 23 55

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Grange Fertilizer Co., Detroit, Mich.		
2770	All Crops Special Fertilizer	Hillsdale	Claimed.... Found......
2922	Complete Manure	Manufacturer's sample	Claimed.... Found......
2771	Corn, Oats and Grass Fertilizer	Hillsdale	Claimed.... Found......
2923	High Grade Concentrated Wheat Manure	Manufacturer's sample	Claimed.... Found......
2772	Potato and Vegetable Fertilizer	Reading	Claimed.... Found......
2864	Wheat Fertilizer No. 1	Lennon	Claimed.... Found......
2878	Wheat Fertilizer with Potash	Plymouth	Claimed.... Found......
	Hirsh, Stein & Co., Chicago, Ill.		
2924	Calumet Bone Black Grain Grower	Manufacturer's sample	Claimed.... Found......
2773	Calumet Bone Phosphate and Potash	Clayton	Claimed.... Found......
2774	Calumet Corn and Wheat Grower	Coloma	Claimed.... Found......
2925	Calumet Fruit and Truck Grower	Manufacturer's sample	Claimed.... Found......
2835	Calumet Grain Grower	Nunica	Claimed.... Found......
2942	Calumet High Grade Garden and Vegetable Grower	Manufacturer's sample	Claimed.... Found......
2775	Calumet High Grade Bone Phosphate and Potash	Clayton	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.03 1.00	10 11.02	.... 0.89	8 10.13	2 3.16	$14 00 16 65
0.82 1.12	9 10.40	.... 1.44	7 8.96	1 1.33	11 41 14 44
1.65 1.77	10 10.70	.... 0.72	8 9.98	2 2.16	16 05 18 04
1.23 1.42	11 11.60	.... 1.50	9 10.10	2 2.13	15 66 17 31
0.82 0.91	10 11.20	.... 0.89	8 10.31	3 3.26	14 21 16 60
....	16 16.80	.... 2.83	14 13.97	....	14 00 13 97
....	12 12.60	.... 0.68	10 11.92	2 2.08	11 80 13 79
2.05 2.50	.... 11.45	1 0.60	8 10.85	1.50 2.10	16 52 21 23
....	.... 13.46	1 1.48	10 11.98	2 2.35	11 80 14 10
0.82 0.94	.... 10.85	1 2.22	8 8.63	4 4.71	14 71 16 86
4.10 4.30	.... 11.00	1 1.32	8 9.68	7 7.81	28 23 31 33
1.60 1.60	.... 10.00	1 1.40	8 8.60	2 2.19	15 32 16 41
2.05 2.46	.... 10.95	1 0.98	8 9.97	6 7.15	20 57 24 92
....	.... 12.75	1 1.16	10 11.59	5 5.26	14 50 16 32

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Hirsh, Stein & Co.—*Con.*		
2776	Calumet Potato, Tobacco and Onion Grower........	Zeeland..............	Claimed.... Found......
2880	Calumet Special Grape Fertilizer..................	Lawton...............	Claimed.... Found......
2777	Calumet Special Potato, Tobacco and Onion Grower..	Coloma...............	Claimed.... Found......
2778	Calumet Special Pure Bone Meal...................	Hillsdale..............	Claimed.... Found......
2780	Calumet Special 10% Potash Manure...............	Zeeland..............	Claimed.... Found......
2779	Calumet Sugar Beet and General Crop Grower.......	Coloma...............	Claimed.... Found......
2926	Calumet Ten-Ten Hummer Potash Phosphate.......	Manufacturer's sample..	Claimed.... Found......
2927	Calumet Universal Crop Grower..................	Manufacturer's sample..	Claimed.... Found......
2781	Calumet Wheat, Corn and Oats Special............	Hudson..............	Claimed.... Found......
	Jarecki Chemical Co., Sandusky, Ohio.		
2951	Black Soil Special..............................	Petersburg............	Claimed.... Found......
2895	Black Soil Special..............................	Lulu.................	Claimed.... Found......
2928	C. O. D. Phosphate.............................	Manufacturer's sample..	Claimed.... Found......
2782	Fish, Phosphate and Potash, Tobacco and Potato Food..	Ithaca................	Claimed.... Found......
2783	Lake Erie Guano with Phosphate and Potash.......	Hillsdale.............	Claimed.... Found......

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.60 2.03	... 10.52	1 1.62	8 8.90	5 5.70	$18 18 21 38
0.82 1.31	20 23.20	... ...	... ...	8 8.06	25 91 30 13
1.60 1.68	... 10.52	1 1.15	8 9.37	10 10.65	22 68 24 97
0.82 1.30	29.70 32.55	... ...	... ...	... ...	26 47 30 31
0.82 0.98	... 7.32	0.50 0.99	5 6.33	10 10.45	16 91 19 37
1.23 1.47	... 10.85	1 1.50	9 9.35	2 2.77	15 26 17 29
... ...	... 11.30	1 0.88	10 10.42	10 10.69	19 00 20 04
0.82 1.15	... 9.35	1 1.30	7 8.05	1 1.53	11 01 13 75
0.82 0.93	... 10.20	1 1.12	8 9.08	3 3.35	13 81 15 62
... ...	... 10.40	1 0.91	8 9.49	8 7.90	15 20 17 51
... ...	... 8.90	1 2.56	8 6.34	8 9.81	15 20 15 17
... ...	... 13.50	1 1.06	12 12.44	... ...	12 00 12 44
0.83 0.92	... 9.30	1 0.53	8 8.77	4 4.28	14 74 15 87
1.25 1.01	... 10.05	1 0.57	8 9.48	2.50 2.08	14 78 14 91

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Jarecki Chemical Co.—*Con.*		
2889	Lake Erie Guano with Phosphate and Potash	New Boston	Claimed Found
2784	Number One Formula	Hillsdale	Claimed Found
2785	Special Sugar Beet Grower	Ithaca	Claimed Found
2786	Square Brand Phosphate and Potash	Ithaca	Claimed Found
2875	Tobacco and Truck Grower	Ithaca	Claimed Found
	Kalamazoo Rendering and Fertilizer Co., Kalamazoo, Mich.		
2787	Kazoo	Kalamazoo	Claimed Found
	Nitrate Agencies Co., New York, N. Y.		
2929	Acid Phosphate	Manufacturer's sample	Claimed Found
2930	Muriate of Potash	Manufacturer's sample	Claimed Found
2931	Sulfate of Potash	Manufacturer's sample	Claimed Found
2932	Nitrate of Soda	Manufacturer's sample	Claimed Found
	Natural Guano Co., Aurora, Ill.		
2788	Pulverized Sheep Manure	Benton Harbor	Claimed Found
	The Pulverized Manure Co., Chicago, Ill.		
2791	Wizard Brand Manure	Jackson	Claimed Found
2943	Wizard Brand Pulverized Sheep Manure	Manufacturer's sample	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.25 1.25	.... 10.58	1 1.32	8 9.26	2.50 2.50	$14 78 16 17
0.83 1.35	.... 10.32	1 0.79	8 9.53	2 2.17	12 94 16 25
0.83 0.90	.... 9.75	1 0.55	8 9.20	4 4.04	14 74 16 03
....	.... 11.05	1 0.66	10 10.39	2 2.32	11 80 12 48
1.66 1.70	.... 8.60	1 0.68	6 7.92	6 6.01	17 28 19 21
1.50 1.35	.... 8.68	2.50 2.44	6 6.24	3 4.04	14 65 15 32
....	.... 17.50	1 2.22	14 15.28	....	14 00 15 28
....	....	....	....	50 50.50	45 00 45 45
....	....	....	....	48 48.22	43 20 43 40
15 15.13	....	....	....	....	49 50 49 93
2.25 2.34	.... 1.47	0.25 0.20	1.50 1.27	1 2.06	9 93 10 93
1.80 2.16	.... 1.47	.... 0.14	1 1.33	1 1.69	7 84 9 99
1.80 2.27	.... 1.65	.... 0.12	1 1.53	1 2.24	7 84 11 04

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Pioneer Fertilizer Co., Chicago, Ill.		
2789	Pioneer General Crop Grower	Saginaw	Claimed Found
2877	Pioneer High Grade Acid Phosphate	Harbert	Claimed Found
2876	Pioneer High Grade Phosphate and Potash	Harbert	Claimed Found
2865	Pioneer Potato and Vegetable Grower	Jackson	Claimed Found
2790	Pioneer Truck and Corn Grower	Manufacturer's sample	Claimed Found
2866	Pioneer 1-7-1 Fertilizer	Jackson	Claimed Found
2867	Pioneer 2-8-4 Fertilizer	Jackson	Claimed Found
	Smith Agricultural Chemical Co., Columbus, Ohio.		
2868	Special Potato Formula	Maybee	Claimed Found
2846	Chicago Fertilizer B. B. & P. Brand	Palmyra	Claimed Found
2847	Chicago Fertilizer Calumet Phosphate	Maybee	Claimed Found
2869	Chicago Fertilizer New Leader	Azalia	Claimed Found
2792	Chicago Fertilizer Potash Special	Reading	Claimed Found
2793	Chicago Fertilizer Western Phosphate and Potash	Reading	Claimed Found
2870	Ohio Farmers Ammoniated Phosphate and Potash	Azalia	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.76	.... 12.30	1 3.70	8 8.60	2 2.41	$15 65 18 06
....	.... 17.80	1 0.30	14 17.50	....	14 00 17 50
....	.... 14.02	1 1.55	10 12.47	4 3.56	13 60 15 67
1.65 1.65	.... 10.10	1 1.06	8 9.04	7 7.09	20 15 21 29
0.82 1.07	.... 12.30	1 2.50	8 9.80	4 4.36	14 71 18 25
0.82 0.96	.... 8.50	1 0.84	7 7.66	1 1.44	11 01 12 47
1.65 1.70	.... 11.25	1 1.48	8 9.77	4 3.53	17 45 19 15
0.81 0.78	.... 8.85	.... 0.84	6 8.01	10 10.20	17 68 19 77
1.23 1.27	.... 10.70	.... 1.34	8 9.36	2 2.12	13 86 15 46
....	.... 13.37	.... 1.74	10 11.63	2 2.07	11 80 13 49
0.82 0.80	.... 14.16	.... 3.64	8 10.52	7 6.84	17 41 20 78
0.81 0.91	.... 9.60	.... 0.86	8 8.74	4 4.11	14 27 15 78
0.81 0.90	.... 9.90	.... 0.92	8 8.98	2 2.43	12 48 14 14
0.81 0.87	.... 9.72	.... 0.91	8 8.81	4 4.14	14 28 15 41

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Smith Agricultural Chemical Co.—*Con.*		
2794	Ohio Farmers Corn, Oats and Wheat Fertilizer	Quincy	Claimed Found
2795	Ohio Farmers Excelsior Phosphate	Reading	Claimed Found
2933	Ohio Farmers Soluble Phosphate and Potash	Manufacturer's sample	Claimed Found
2845	Ohio Farmers Wheat Maker and Seeding Down	Maybee	Claimed Found
	Speidel and Swartz, Grand Haven, Mich.		
2836	Celery Hustler	Grand Haven	Claimed Found
	Swift and Company, Chicago, Ill.		
2796	Bean and Grain Grower	Galien	Claimed Found
2797	Complete Fertilizer	Zeeland	Claimed Found
2800	Complete Fertilizer	Jackson	Claimed Found
2934	Diamond S Phosphate	Manufacturer's sample	Claimed Found
2798	Early Potato and Vegetable Grower	So. Haven	Claimed Found
2890	Early Potato and Vegetable Grower	Dearborn	Claimed Found
2891	Early Potato and Vegetable Grower	Holland	Claimed Found
2801	Garden City Phosphate	Jackson	Claimed Found
2935	Ground Steamed Bone	Manufacturer's sample	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.23 1.26	9.73	1.42	8 8.31	2 2.25	$13 86 14 50
0.81 0.82	9.82	0.68	8 9.14	7 7.03	16 98 18 18
	12.45	0.90	10 11.55	2 1.86	11 80 13 22
0.81 0.83	9.75	1.02	8 8.73	2 2.06	12 48 13 32
6 6.51	4.97	0.69 0.69	3.17 4.28	1.25 1.90	24 38 27 75
0.82 0.94	10.17	1 1.24	8 8.93	3 3.41	13 81 15 60
1 1.19	10.25	1 1.28	8 8.97	1 1.26	12 60 14 54
1 1.14	10.90	1 1.72	8 9.18	1 1.59	12 60 15 06
	12.10	1 0.94	10 11.16		10 00 11 16
3.29 2.64	10.19	1 1.01	6 9.18	10 9.04	26 26 26 43
3.29 3.35	9.70	1 2.17	6 7.53	10 8.37	26 26 26 99
3.29 2.44	9.50	1 1.04	6 8.46	10 10.22	26 26 26 13
	16.52	1 0.73	14 15.79		14 00 15 79
1.65 1.92	20 21.60				21 45 23 62

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Swift & Company.—*Con.*		
2802	Onion, Potato and Tobacco Fertilizer	Galien	Claimed Found
2936	Potato, Celery and Onion Grower	Manufacturer's sample	Claimed Found
2799	Pure Bone Meal	Jackson	Claimed Found
2804	Special Phosphate and Potash	Zeeland	Claimed Found
2892	Special Phosphate and Potash	Waltz	Claimed Found
2805	Sugar Beet Grower	Alma	Claimed Found
2897	Sugar Beet Grower	Galien	Claimed Found
2944	Sugar Beet Special	Manufacturer's sample	Claimed Found
2806	Superphosphate	Three Oaks	Claimed Found
2807	Truck Grower	Hudson	Claimed Found
2803	Raw Bone Meal	Bay City	Claimed Found
2809	Muriate of Potash	Jackson	Claimed Found
2810	Nitrate of Soda	Jackson	Claimed Found
2808	Vegetable Grower	Bay City	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.66	.... 10.22	1 1.16	8 9.06	7 7.24	$20 15 21 52
0.82 1.25	.... 9.65	1 2.26	5 7.39	10 11.83	17 11 23 07
2.50 2.63	24 24.90	....	....	....	27 45 28 60
....	.... 11.87	1 0.89	10 10.98	2 1.81	11 80 12 61
....	.... 12.25	1 1.13	10 11.12	2 1.83	11 80 12 77
2.50 2.31	.... 12.32	1 1.72	8 10.60	5 6.02	21 15 24 34
2.50 2.41	.... 12.85	1 2.46	8 10.39	5 5.13	21 15 23 94
0.82 1.23	.... 12.90	1 2.48	8 10.42	3 3.83	13 81 18 92
1.65 1.78	.... 10.80	1 1.54	8 9.26	2 2.39	15 65 17 91
0.82 0.98	.... 10.82	1 1.22	8 9.60	4 4.00	14 71 16 92
3.75 3.97	23 23.45	....	....	....	30 78 31 86
....	....	....	....	50 51.46	45 00 46 31
15.63 15.61	....	....	....	....	51 58 51 51
3.29 2.95	.... 11.25	1 0.49	9 10.76	10 9.22	29 26 29 49

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Tuscarora Fertilizer Co., Chicago, Ill.		
2937	Acid Phosphate	Manufacturer's sample	Claimed Found
2811	Ammoniated Phosphate	Zeeland	Claimed Found
2812	Bone and Potash	Coloma	Claimed Found
2813	Michigan Special	Zeeland	Claimed Found
2814	Tuscarora Bone Phosphate	New Buffalo	Claimed Found
2815	Tuscarora Fruit and Potato	Zeeland	Claimed Found
2938	Tuscarora Garden	Manufacturer's sample	Claimed Found
2816	Tuscarora Standard	New Buffalo	Claimed Found
2817	Wolverine Special	New Buffalo	Claimed Found
	Wuichet Fertilizer Co., Dayton, Ohio.		
2818	Buckeye Onion and Truck Fertilizer	Manchester	Claimed Found

1911, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 16.30	0.50 0.32	14 15.98	....	$14 00 15 98
0.82 0.97	.... 9.80	0.50 0.79	7 9.01	1 1.04	10 81 13 47
....	.... 10.65	0.50 0.21	10 10.44	2 2.60	11 80 12 78
1.65 1.70	.... 10.22	0.50 1.14	8 9.08	5 5.94	18 15 20 50
....	.... 11.62	0.50 0.60	10 11.02	....	10 00 11 02
1.65 1.67	.... 10.30	0.50 1.07	8 9.23	10 10.73	22 75 24 83
2.88 2.85	.... 10.50	0.50 1.96	8 8.54	4 4.62	21 30 22 89
1.65 1.61	.... 9.72	0.50 0.84	8 8.88	2 2.07	15 45 16 39
0.82 0.98	.... 9.55	0.50 0.70	8 8.85	4 4.10	14 51 16 06
1.50 1.51	.... 13.23	1 2.31	8 10.92	8 6.84	20 55 22 98

BULLETIN 266 **AUGUST, 1911**

MICHIGAN
AGRICULTURAL COLLEGE
EXPERIMENT STATION

POULTRY HUSBANDRY DEPARTMENT

POULTRY HOUSE CONSTRUCTION AND YARDING

BY

H. L. KEMPSTER

EAST LANSING, MICHIGAN.
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The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, East Lansing, Michigan.

MICHIGAN AGRICULTURAL EXPERIMENT STATION

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Railroad and Express Address,	Lansing, Mich.

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SUB-STATIONS

Chatham, Alger County, 160 acres deeded—Leo. M. Geismar in charge.
Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded—Frank A. Wilkin in charge.

FOREWORD.

This bulletin is a companion to number 260, published March, 1910, which was entitled *Seeds of Michigan Weeds,* and the two can profitably be studied together.

The aim has been not to repeat much that has been so recently published.

Very nearly all the drawings were made by F. Schuyler Mathews of Cambridge, Massachusetts. Figures 2, 3, 4, 4a, 8, 10, 11, 12, 16, 19, 20, are taken from Bulletins by the U. S. Dept. of Agriculture.

I am indebted to Dr. B. L. Robinson and M. L. Fernald of the Gray Herbarium of Harvard University for valuable hints and access to numerous herbarium specimens.

In all the plans made for extermination of weeds do not forget that when buried in the soil, a portion of the seeds of many weeds will retain their vitality for 30 years at least.

Two numbers are given to most of the illustrations, the one in parenthesis is the number corresponding to that of the cut in bulletin 260.

In the study of weeds as in the study of other plants it is well to group them according to some of their points of agreement.

In this treatise, I have given a brief popular account of each family that contains one or more weeds here illustrated.

Placing these cuts one to three to the page according to shape and size makes it impossible in many cases to arrange the species in approved sequence. In spelling and capitals I follow Gray's Manual, 7th Edition.

In the back part of the bulletin are duplicate copies of the decimal scale that any one can cut out and use for a measure, though these figures are not all natural size.

W. J. BEAL.

OBJECT OF THIS BULLETIN.

This bulletin is not intended as a full text concerning weeds and remedies for disposing them; the chief object is to furnish illustrations that will aid students in school and college and farmers out of school to recognize some of the more striking weeds.

The descriptions are purposely short and mostly popular. The botanist will not need the text, but will consult a reliable text book such as *Gray's Manual of Botany, 7th Edition.* The person not trained in botany will get little from the text. In case of the "pictures," in many cases they will not be very satisfactory to the uninitated.

I hope that bulletin 260 and the present one will induce a few farmers at least to adopt better methods.

While I cannot predict what new weeds may be introduced, thrive and spread in Michigan, I have included several not yet prominent because of their bad record in near-by regions.

No person can know better than I do the very rapid increase in the number of weeds on Michigan farms. As a rule each farm is annually getting more sorts of weeds and as each farmer is cultivating weeds, these are becoming more freely distributed in every field and along every roadside.

EXPERIENCE OF THE GERMANS AND ENGLISH.

What has been the experience of older countries, such as Germany and Great Britain? Previous to 1860, it was a very common practice to mix old seeds with new of the same variety. The old seeds will not grow, or most generally if they do grow they produce inferior plants. Another common practice is to kill seeds of charlock by boiling or baking, then assort the seeds into two sizes by means of a sieve. The larger seeds were used to mix with rutabagas, the smaller with turnip seeds. In such cases all the seeds which grow are good, but the purchaser is deceived in the quantity he buys and in the amount of which he sows on a given space. Old seeds, or seeds of another variety, were often dyed and used to adulterate good seeds of red clover and other species. Sulphur-smoking is often resorted to, to renovate the appearance of worthless old grass seed. Some seeds are dressed with oil for a similar purpose. There were many experts in the business who carried on a regular exchange in doctored seeds.

In a case in Germany, 59 per cent of seeds corresponded to the labels under which the articles were sold, and only 18.3 per cent were capable of germination. A sample of orchard grass contained 39 other species of seeds. In a sample sold for Meadow Foxtail, only one-half the seeds were of this species, and of the genuine seeds only 5 per cent were alive and capable of germinating, so that 100 lbs. of the seeds as sold furnished 50 lbs. of inferior, worthless, or injurious foreign seeds and only 2½ lbs. of seeds capable of producing plants of the species for which they were sold. All the samples referred to came from dealers who ranked among "the reliable" in Germany. In 1868 over 3 tons of so-called red clover seed were sold to farmers in the Saxon city of Chemnitz alone, of which two-thirds was yellow clover. Of 51 specimens of red clover seed, 31 were found to contain seeds of the dodder, "the destructive (parasitic) enemy of the clover plant." In another case, "of samples of timothy seed, the best yielded 99 per cent of sound seeds, the poorest 15 per cent, while the average was 82 per cent." To the tradesmen "troublesome questions are put if the seed is found better or worse one year than another," so they get accustomed to adulterating and keeping seeds of about the same average year after year. One advantage of using dead seeds is that they tell no tales in the shape of feeble plants, or of plants other than the variety desired. In Prussia at present, government experts are appointed to test seeds for merchants and for farmers and gardeners.

In Germany, one or more firms, formerly at least, ground up quartz, sifted it and colored it to resemble seeds of red clover, with which it was mixed. It requires close examination with a miscroscope to detect the quartz from the clover seed.

In 1869, it is estimated that in England alone, 20,000 bushels of poor turnip seed was sown mixed with good seeds. A few brief experiments will enable anyone to tell which seeds are dead and which will grow, but it requires more time to tell which are weak and which are strong, or to tell which are true and which untrue to the name put on the package.

There appeared at one time, and perhaps it still exists, an organized agreement among seedmen of England, with perhaps some exceptions, to adulterate certain sorts of seeds to just such an extent. Pure fresh seed they quote as "net seed," while dead seed is quoted as "tri" or "000." In some seasons they agree to adulterate cauliflower so that a package shall contain only 50 to 60 per cent of good seeds. At one time 18 packages of seeds of cauliflower were taken to contain from 86 to 24 per cent of good seeds, averaging 51 per cent; 18 samples of seeds of broccoli ranged from 86 to 35 per cent, averaging 51 per cent; 18 of carrot seeds ranged from 61 to 14, and averaged 40 per cent of good seeds. The same number of packages of white turnip seed ranged from 98 to 57, averaging 74 per cent of living seeds.

In Great Britain they now have a law passed making it a fine of not over five pounds for the first offense and fifty pounds for the second offense to dye or kill and sell worthless seeds. Besides the fine, the court has authority to advertise the name of the offender in any newspaper at the expense of the guilty party. No wonder those who manage farms in Germany, England and other old countries chafed under this imposition. They agitated the subject and began to enact laws with penalties attached to them. If I mistake not, the first seed-control station was started by Dr. Nobbe of Saxony in 1869 and many others have followed.

Adulterations of seeds were discovered most ingenious in character, harmful in effect, and remarkable in amount.

Since 1871, members of the Royal Agricultural Society of England have among their officers a consulting botanist, William Caruthers, 44

Central Hill, Norwood, London, S. E., who made his first report in 1872, and continued in service certainly until 1905. His successor is still acting in the same capacity. Members of the society can avail themselves of his advice by paying a small fee varying in amount according to the service rendered. Although but few farmers avail themselves of the advice of the consulting botanist, the purity and quality of grass seeds and those of other forage plants, rapidly improved, until today there is very little cause for complaint.

WEED SEEDS OFTENEST MET WITH IN CLOVER SEED.

In the year 1910, 122 lots of seeds of red clover were selected by our agent where offered by the merchant for sale. These were examined at the Agricultural College and 51 kinds of seeds of weeds were detected. Nine samples only of the whole number contained no weeds.

Seventy samples of clover seed contained seeds of *Setaria viridis* (green foxtail).

Sixty samples contained *Plantago lanceolata* (buckhorn).

Fifty-eight samples contained *Plantago Rugelii* (Rugel's plantain).

Fifty samples contained *Rumex crispus* (narrow-leaved dock).

Forty-six samples contained *Rumex Acetosella* (sheep sorrel).

Thirty-six samples contained *Polygonum Persicaria* (lady's thumb).

Thirty samples contained *Chenopodium album* (lamb's quarters).

Twenty-three samples contained *Plantago major* (one of the broad-leaved plantains).

Twenty-three samples contained *Echinochloa crus-galli* (barnyard grass).

Twenty-one samples contained *Ambrosia artemisiifolia* (common ragweed).

Seventeen samples contained *Panicum capillare* (hair grass).

Sixteen samples contained *Digitaria sanguinalis* (crab grass).

Fifteen samples contained *Potentilla monspeliensis.*

Fourteen samples contained *Amaranthus retroflexus* (our most common rough pigweed).

Thirteen samples contained *Lepidium virginicum* (one of the pepper grasses).

Nine samples contained *Setaria glauca* (yellow foxtail or pigeon grass).

Nine samples contained *Stellaria media* (our most common chickweed).

Eight samples contained *Nepeta Cataria* (catmint or catnip).

Seven samples contained *Lepidium apetalum* (a small pepper grass).

Six samples contained *Prunella vulgaris* (self heal).

Five samples contained *Cerastium vulgatum* (mouse-ear chickweed).

Four samples contained *Bromus secalinus* (common chess).

Three samples contained *Rumex obtusifolius* (broad-leaved dock).

Three samples contained *Anthemis Cotula* (Mayweed).

Three samples contained *Oenothera biennis* (evening primrose).

Three samples contained *Daucus Carota* (wild carrot).

Two samples contained *Digitaria linearis* (narrow-leaved panicum).

Two samples contained *Lithospermum arvense* (red root).

Two samples contained *Lolium perenne* (perennial rye grass).

Two samples contained *Portulaca oleracea* (purslane).

Two samples contained *Cichorium Intybus* (chickory).
Two samples contained *Brassica nigra* (black mustard).
Two samples contained *Cirsium arvense* (Canada thistle).
Two samples contained *Cuscuta arvensis* (dodder).
Two samples contained *Verbena urticifolia* (nettled-leaved verbena).
One sample contained *Medicago lupulina* (black medick).
One sample contained *Ranunculus bulbosus* (bulbous crowfoot).
One sample contained *Ranunculus repens* (creeping crowfoot).

NO VERY EASY WAY TO DESTROY.

The great mass of farmers and gardeners think to kill a weed by some royal easy process, such as mowing in a certain phase of the moon or a certain definite period in the year or by once or twice cultivating. After the cultivator he waits until the leaves are several inches high before making the next effort. Such persons will always have the company of a weed after its first introduction into his field or garden.

To kill countless thousands of weeds coming from seeds, cultivate the ground weekly during the growing season and do not permit the weeds to go to seed, or, if this is too costly, let the weeds have their own way except during the early growth of cultivated crops. Frequent cultivation is necessary to a first class yield.

TO KILL WEEDS IN A LAWN.

In case of weeds in a lawn, most of them may be kept in check by enriching the ground liberally, enabling the better grasses to thrive by "driving the weeds to the wall."

HOW TO DEAL WITH QUACK GRASS.

The following concerning quack grass, contains points that will apply to many other weeds.

I have long considered quack grass, *Agropyron repens,* the worst weed that vexes the tiller of the soil in Michigan. It is because it holds its own well and spreads whenever there is a chance, and chiefly because the farmer does not recognize it until it is scattered far and wide. It is carried by the plow, harrow, and cultivator from one end of the field to the other. To have a farm well seeded to this grass is a calamity to be avoided.

All that is *needed* to exterminate a field of quack grass *is the right kind of a man* who will carefully observe and study the plant, fighting with method and thoroughness.

I have killed 100 or more patches and can speak from practical results and success. *Plants of this sort cannot gain any if the green leaves are not allowed to appear. The nourishment stored in the white root stocks underground will aid the plant to send up slender leaves and if these remain, the plants gain and recruit, but if the leaves start underground and are cut off before coming to the light, these white rootstocks are drawn on again to furnish food to start more leaves and thus, in time become exhausted.* If convenient, pasture closely for a whole growing season which prevents the production of new thrifty rootstocks then, if the sod be well turned under deep, rolled and harrowed, much of the grass will be killed at once. Ordinarily I plow late in the fall or very early in spring, rain or shine, wet or dry, or even in June, and cultivate with a shovel-toothed cultivator every three days till the middle of June, or later if starting the work later. Rarely, if the weather be wet and hot, cultivate every two to two and a half days. Keep all green leaves from showing themselves. Do not delay to see green leaves. A harrow that does not cut off the stems below the surface of the ground is not efficient.

The worst luck I ever had in this work was in summer-fallowing a piece of quack grass during a dry year. A good deal of it remained dormant and grew the following spring.

One year I tried the application of salt on one side of the bank of a brook where cultivation was very inconvenient. The strip of grass was about four rods long and the slope about five feet. Whenever seen a little at a time two barrels of salt were freely applied for the whole growing season, and the next spring the grass started up in several places ready to continue the fight, which was abandoned on that line.

For five years I tried (on the banks of a brook, or where there were only small patches) the following scheme, with great satisfaction:

During the wet and growing part of a summer I put on tarred building paper, taking care to have it overlap and completely exclude every ray of light. Six weeks to two months is enough, possibly four to five weeks, if the weather is hot and wet.

Very likely the reader will think this method costly and will hesitate and dally along, giving the grass a good chance to extend its domain. It is not worth while to plow deep or rake out the rootstocks. It is much better to be thorough in spring during a growing time than during a drouth. I mean that it can be subdued faster in wet weather than in dry. When very dry the underground stems remain dormant. Of course, small patches can be dug over with a hoe.

Where one is neat and thorough he may prefer to take two or three years in the extermination, growing two or three crops of corn in succession.

With all the talk about the importance of sowing clean seeds, the killing of weeds by a rotation of crops, the value of plow, cultivation, harrow, mower, rake, hoe, spade, urgent appeals come from the man whose field of oats is yellow with the flowers of mustard or whose lawn is yellow with dandelions.

He seeks information regarding

THE SPRAYING WITH CHEMICALS.

In the absence of long continued and thorough experiments at this college in spraying weeds, I quote from bulletin 80, 1908, of the Experiment Station, North Dakota, where Professor H. L. Bolley began this kind of work in 1896 continuing ever since for fourteen years. After all, he "Is not over sanguine in this matter, still the proper handling of spraying machinery and proper spraying at the proper time gives splendid results in weed destruction without material injury to growing cereals, to grass of the pasture lands or to lawn grasses.

"In many places it is difficult to secure good apparatus at reasonable prices. Again, it is difficult to convince some that the cheap potato sprayer, which has no power capacity, cannot be made to serve the purpose.

"For use in grain fields, the cart should be fitted with a pole for two or more horses. The wheels should be of low form and have wide tires, 3½ to 4 inches. For work on small farms the tank should hold at least 52 gallons.

"All parts in contact with the solution should be either wooden, brass or rubber. Even galvanized iron is readily destroyed by the solutions used to eradicate weeds.

"The spray beam should carry nozzles sufficient to throw in a forceful, misty spray from one to one and one-fourth barrels of liquid for each acre of ground. The pump should give a pressure of about 100 or more pounds per square inch, shown by a gauge attached. Many questions are involved. The abundance and the sturdiness of the crop and the weeds; the climate, the growing season; whether the weeds are growing in dense, persistent clumps, such as Canada thistles, and whether it is important to undertake to save the crop in the particular spots or not. Do not buy patent or highly advertised chemical-weed eradicators, but instead buy chemical substances on the market.

"The station has used, successfully, in various sorts of weed-eradication work, common salt, iron sulfate (copperas, green vitriol) copper sulfate. (blue stone of blue vitriol), corrosive sublimate (mercuric bichloride) and sodium arsenite ($NaAs\ O_2$). Great care should be taken in using some of these.

"This chemical method of weed eradication has the peculiar merit that the weeds may be attacked while a crop is being grown and the crops will still give an increased yield. 'Chemicals act differently upon the members of different families of plants.'

"One field sprayer, with proper help, can spray from twenty-five to forty acres per day.

"Good field sprays cost from $60 to $150. Good hand sprayers, for dandelions and patches of Canada thistles, etc., may be had at $8 to $10. Iron surfate in powdered form, ready for use in solution, was available in Grand Forks and Fargo for .90 to $1.10 per hundred pounds.

"The question as to when to spray must be settled by a number of considerations, crop conditions, the weed growth, and weather.

"Good results have been obtained in spraying oats, wheat and barley when the grain is eight to twelve inches high, to kill mustard and king head (giant ragweed). Mustard is most easily killed when it is just beginning to blossom, though iron sulfate is effective against this weed at all stages up to the forming of seeds.

"The most effective spray for Canada thistle is sodium arsenite at the rate of 1½ to 2 pounds per 52 gallons of water. The next most effective spray is common salt at the rate of one-third to one-half barrel to 52 gallons of water, in either case to be used where the thistles are in compact masses.

"In fighting the dandelion by means of chemical sprays, late experiments indicate that spraying will eventually give marked success, by using iron sulfate, spraying once a month. Plantain also gradully dies out under the spraying. For ordinary lawn purposes the ideal apparatus is the compressed air type of hand spraying machine, keeping up a fine spray under high pressure, using two-pounds of iron sulfate for each gallon of water, or a weaker solution, one and one-third to one gallon of water. Do not spray until two or three days after cutting and then wait two or three days before cutting again. Spray on bright days. As seeds are blowing about a total and permanent eradication cannot be expected.

"Spraying has destroyed the following weeds; False-flax, worm-seed mustard, tumbling mustard, common mustard, shepherd's purse, pepper-grass, ball-mustard, corn cockle, chickweed, dandelion, Canada thistle, bindweed, plantain, rough pigweed, rag-weed, cocklebur.

"The writer wishes to emphasize two points: After killing most of the dandelions, do not neglect to add seeds of June grass and keep fertilizing the lawn, as dandelions seldom do harm where the grass is thick."

MICHIGAN WEEDS.

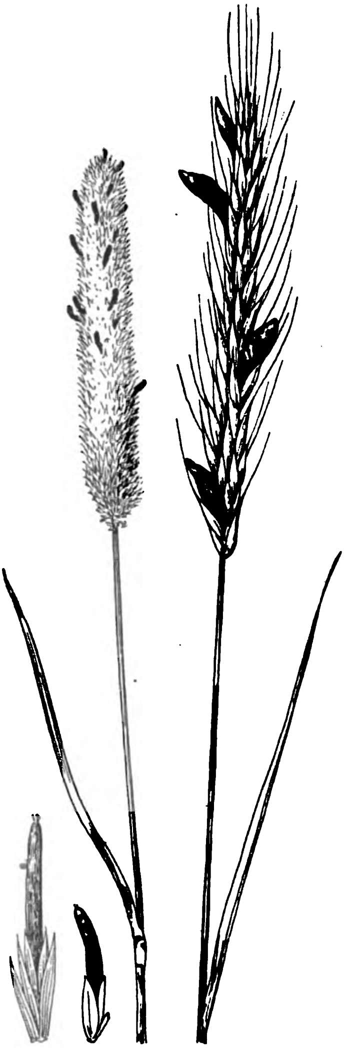


Fig. 1 (1.)

ASCOMYCETES.

Ergot. Spurred Rye. *Claviceps purpurea* (Fr.) Tul. Fungi bearing spores produced in definite number (often 8) in specialized cells, asci.

This is a poisonous fungus sometimes appearing on the grains of rye, timothy, red top and other grasses and is mentioned here because its nature is frequently misunderstood.

About fifteen of these growths are here represented as projecting from a spike of meadow foxtail and four large growths from a spike of rye. This is only the first stage of the fungus, of which there are several others not represented, appearing the following year.

GRASS FAMILY. GRAMINEAE.

There are many widely different plants which in popular language have the name "grass" attached to them, such as knot-grass, rib-grass, cotton-grass, sea-grass, eel-grass, sedge-grass, the clover and others, but these do not belong to the family here under consideration.

Grasses which are grown chiefly for the use of their grain, such as Indian corn, wheat, oats, barley, rye, rice, doura are called cereals.

Besides the cereals the family includes sugar cane, millet, bamboo, timothy, red-top, June grass, fowl meadow grass, blue joint, buffalo grass, orchard grass, meadow foxtail, the fescues, rye-grass, oat-grass, Bermuda grass, and other pasture grasses, and, as will here be seen, the family is conspicuous for a considerable number of weeds.

The grass family heads the list of food producing plants, which are the foundation of all agriculture. Of the staple crops of the United States, the grass family contributes about five-sixths of the total value. There are about 3,500 species of grasses.

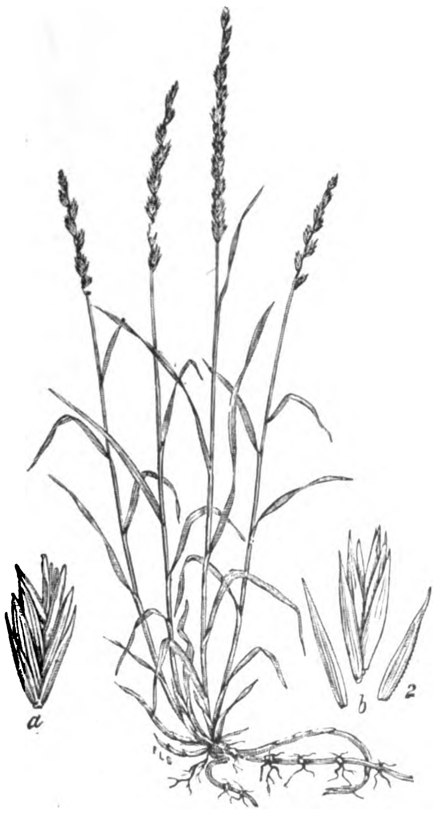


Fig. 2 (2).

Quack Grass. Couch Grass. *Agropyron repens* (L.) Beauv. A mooths pale green perennial, very variable, 30-120 cm. high, with long creeping, jointed rootstocks; spikes 6-20 cm. long, erect or bent; spikelets 10-20 mm. long, 2-8-flowered, florets overlapping for three-fourths of their length or more; empty glumes each unsymmetrical, 7-11 mm. long, first strongly 5-6-nerved, second 7-8-nerved, acute or notched, margins scarious, floral glume about 1 cm. long, those above shorter, 5-nerved near the short awned apex.

Found in Europe, North Africa, Asia and extensively naturalized in cultivated grounds in North America. The rootstocks fill the soil, much resembling those of June grass, except they are larger; the flat, twisted leaf-blades near the ground are not easily distinguished from those of timothy It seldom produces seeds till the plants becomes dwarfed by crowding.

I have long considered quack grass the worst weed in Michigan because it holds its own well and spreads whenever there is a chance and chiefly because the farmer does not recognize it until it is scattered far and wide.

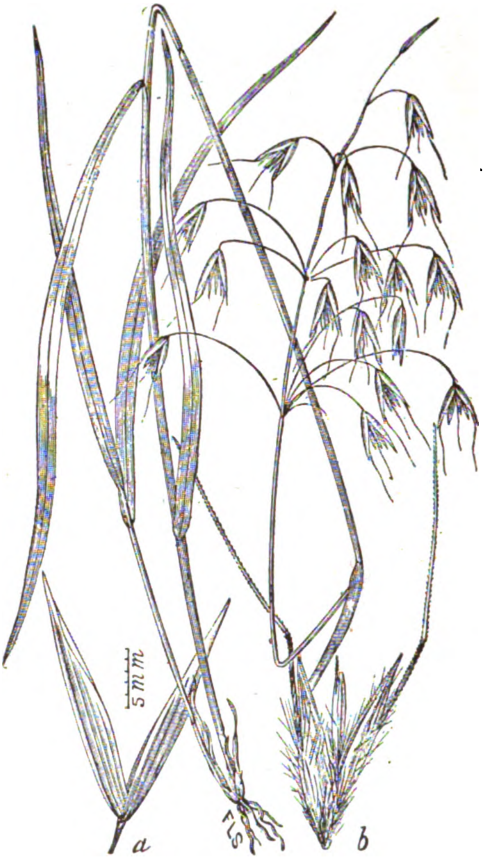


Fig. 3 (3.)

Wild Oat. *Avena fatua* L. This annual plant has much the appearance of the oats in cultivation, of which some consider this the parent form. The species has attached to the back of the floret a conspicuous awn, twisted and bent when dry, besides the firm floral glume is thinly clothed with stiff slender hairs, and these aid it much in distribution by adhering to the fleeces of animals and to the inside of grain sacks. Troublesome in Oregon, California, Canada and neighboring regions where cereals are extensively grown, but as yet seldom seen in Michigan. Introduced from Europe.

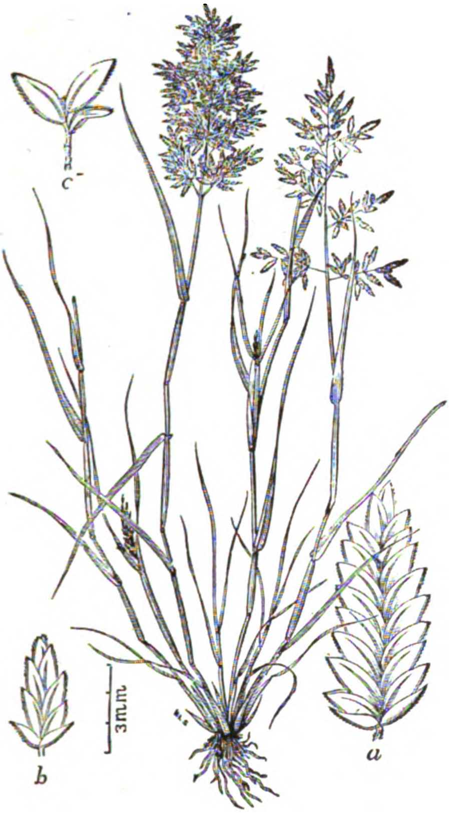
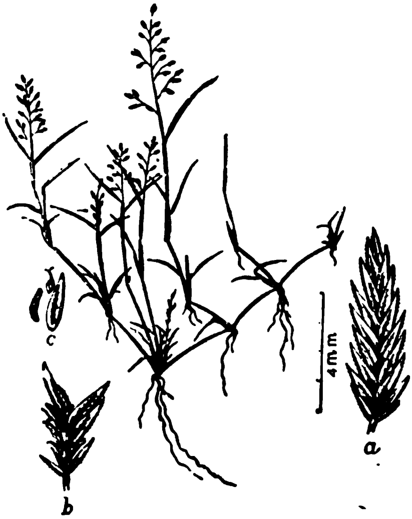


Fig. 4 (15).

Stink Grass. ***Eragrostis megastachya*** **Koeler) Link. (*E. major* Host. *E. eragrostis* (L.) Karst. *E. poaeoidis* Beauv.)** A spreading and much branched annual, 10-25 cm. high, **the leaves bearing glands that secrete a substance very offensive to grazing animals.** Panicle ovoid or linear rather dense, 5-15 cm. long; spikelets flat, lead-colored, 8-20 flowered. Sandy waste places; introduced from Europe.



(Fig 4a.)

Eragrostis hypnoides **(Lam.) B. S. P. (*Eragrostis reptans* Nees.)** A light green prostrate, much branched and very variable annual, extensively creeping late in the season along ditches and wet land, 5-30 cm. high; spikelets flat, 10-40 flowered, borne on open panicles. Extensively distributed in the United States, Canada, Mexico and South America. The little thing seems to have no good common name.

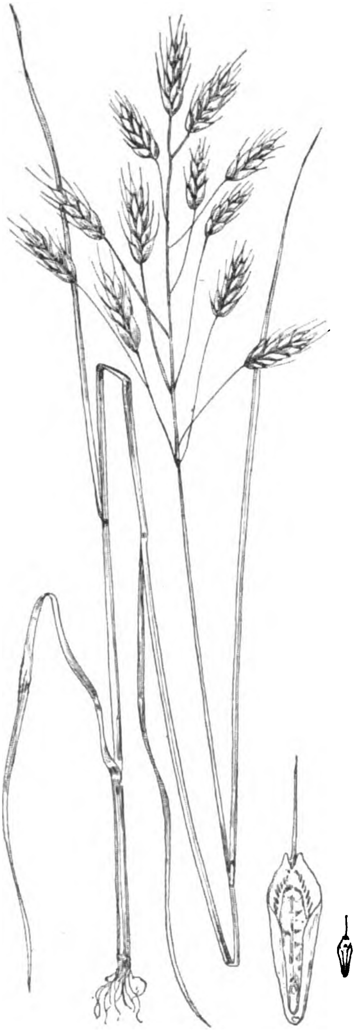


Fig. 5 (5).

Soft Chess. *Bromus hordeaceus* L. (*Bromus mollis* L.) This plant is becoming frequent in waste places; an annual, 10-45 cm. high. The whole plant is soft hairy. Introduced from Europe.

Field Chess. *Bromus arvensis* L. and **Smooth Brome-grass.** *Bromus racemosus* L. Mentioned in Bulletin 260, are only rarely met with in this country. They have much the appearance of the common chess of our wheat fields, excepting the spikelets are softer and the awns longer. Some authors believe these three are mere forms of the same species. All of them are natives of Europe.

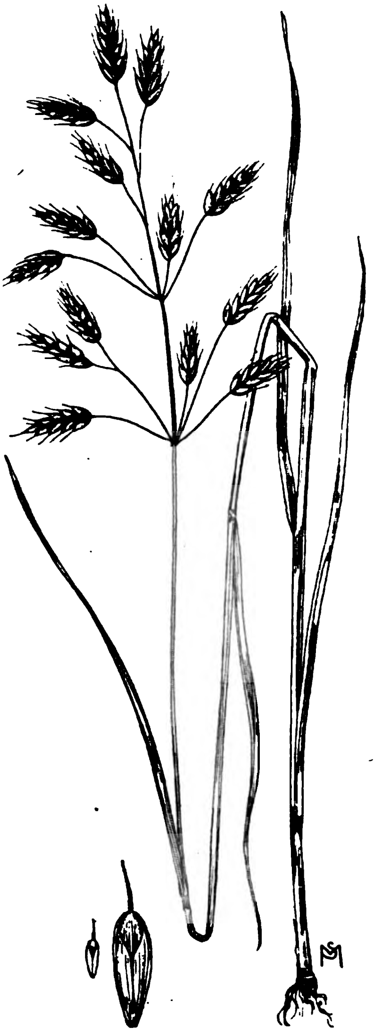


Fig. 6 (7).

Chess, Cheat. *Bromus secalinus* L. Too common where it thrives with winter wheat, because like wheat, it needs to make some growth in autumn and matures in summer ready for harvesting and threshing with the wheat from which it is not easily wholly separated.

Specimens of this plant are occasionally met with in the field and harvested with red clover cut for seed. After threshing it goes with clover seed into a machine for a thorough rubbing which takes off some of the adherent inner chaff and often breaks off a little from one or both ends of the grain. Grains of chess thus mutilated are not uncommonly found mixed with clover seed and the two are sown at the same time. Introduced from Europe.

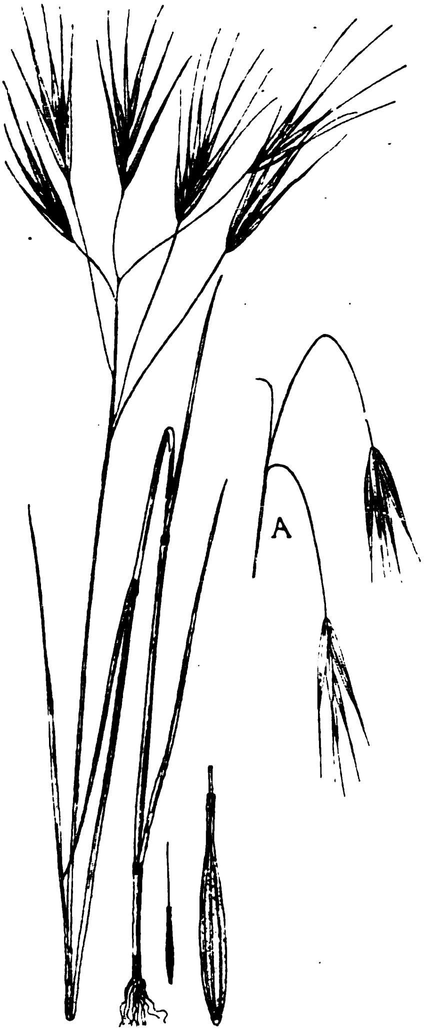


Fig. 7 (8).

Barren Brome Grass. *Bromus sterilis* L. A soft annual appearing in several places in the state, about 50 cm. high. The drooping spikelets are correctly shown at A. Introduced from Europe.

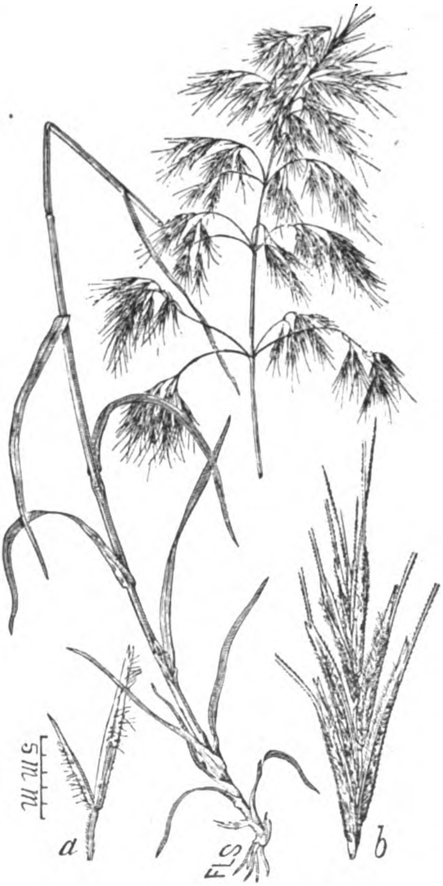


Fig. 8.

Downy Brome Grass. *Bromus tectorum* L. Stems erect, tufted, slender, 30-60 cm. high; leaves softly pubescent; panicle broad, one-sided, drooping, 6-15 cm. long; spikelets 10-20 mm. long.

Grand Rapids, Detroit, Bay County, spreading rapidly where introduced. Naturalized from Europe.

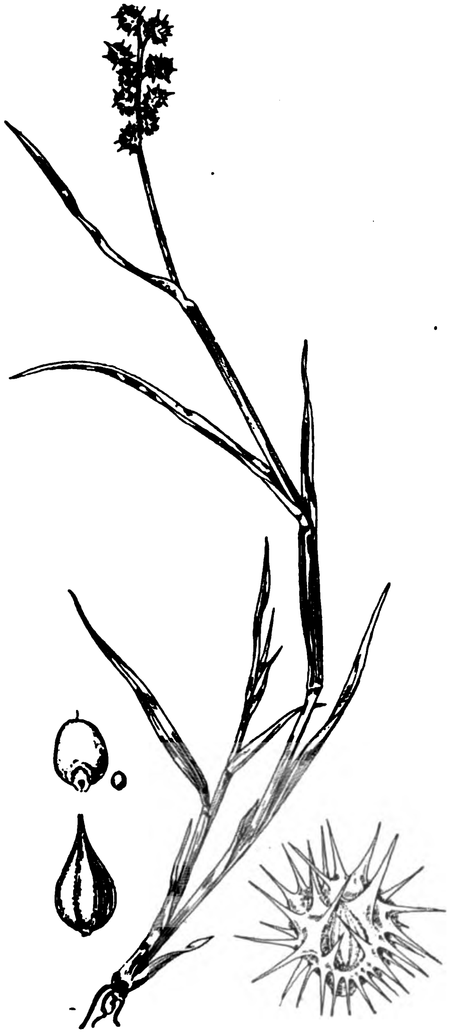


Fig. 9 (9).

Sandbur. Bur Grass. *Cenchrus tribuloides* L. Annual, with flattened spreading branches, about 30 cm. high. Each usually bearing 6-20, hard formidable burs inside of which the grains are produced.

The numerous, sharp diverging and minutely barbed prickles enable the burs to adhere to fleeces of animals and gain free transportation.

Sandy fields, borders of streams and lakes, widely distributed in North America and South America.

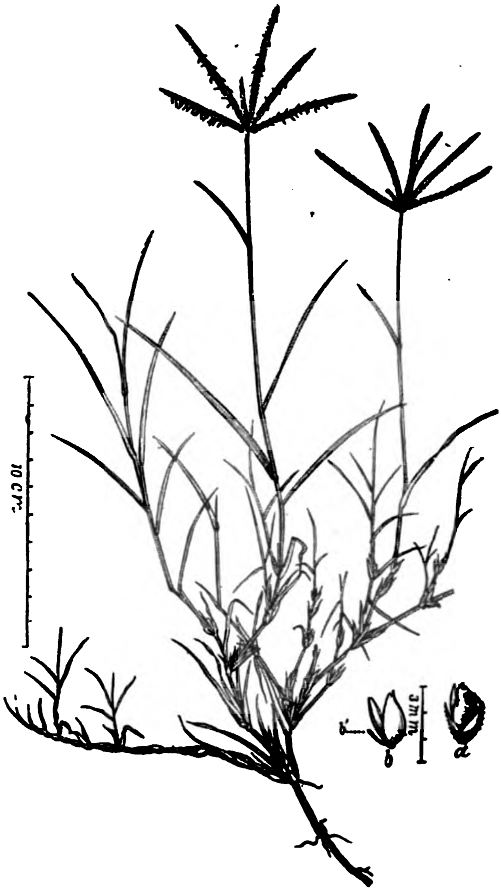


Fig. 10 (10).

Bermuda Grass. Scutch Grass. Dog's-tooth Grass. *Cynodon Dactylon* (L.) Pers. (*Capriola Dactylon.*) This grass-weed is a child of the sun and thrives all over hot countries, but at the same time it is a very valuable grass for pastures in the southern United States and is the very best thing to hold the fine soil on the artificial banks bordering the Mississippi.

The stems creeping on the surface and below are large, stout and wiry, making the land difficult to cultivate. In the southern states, Bermuda grass is the worst weed cotton growers have to contend with. In central Michigan the plant is killed back to the ground with the first hard frost, and during winter it is usually killed several inches below the surface. The succeeding year it starts with great deliberation, scarcely showing itself before July. Its season of about three months gives no promise of value for pasture in Michigan.

When everything is considered, I think quack-grass is one of the worst weeds that vexes the farmers of the state. In a number of places, I know Bermuda and quack grass have come in contact and both have attempted to occupy the same ground at the same time with the result that very little quack grass is left after Bermuda has once taken hold.

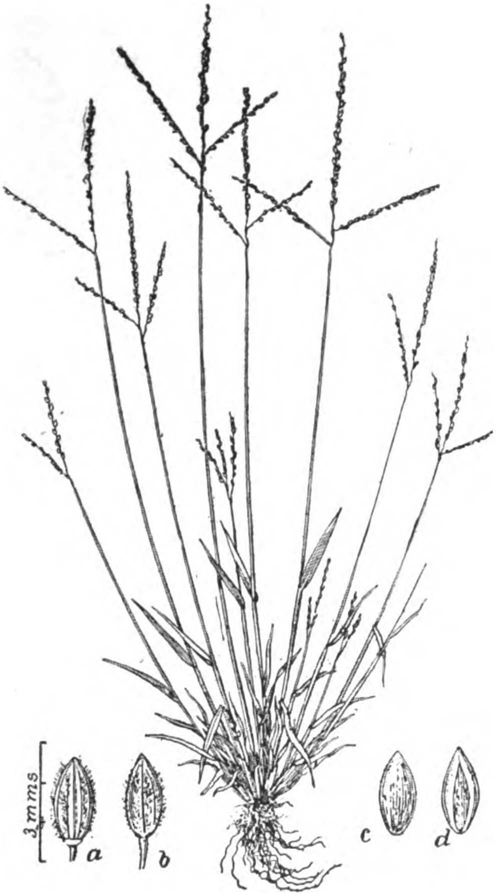


Fig. 11 (11).

Small Crab-grass. *Digitaria humifusa* Pers. (*Panicum lineare* Krock. *Syntherisma linearis* (Krock.) Nash.) A smooth, slender annual with stems usually prostrate, spreading, 15-35 cm. high, each stem bearing 2-6 slender one-sided spikes. Whole plant of a reddish hue, not rooting at the nodes. Common in thin lawns and pastures late in the summer. Unless crowded the stems are prostrate. Introduced from Europe.

If lawns and meadows are enriched, the better grasses and clovers will crowd this plant out.

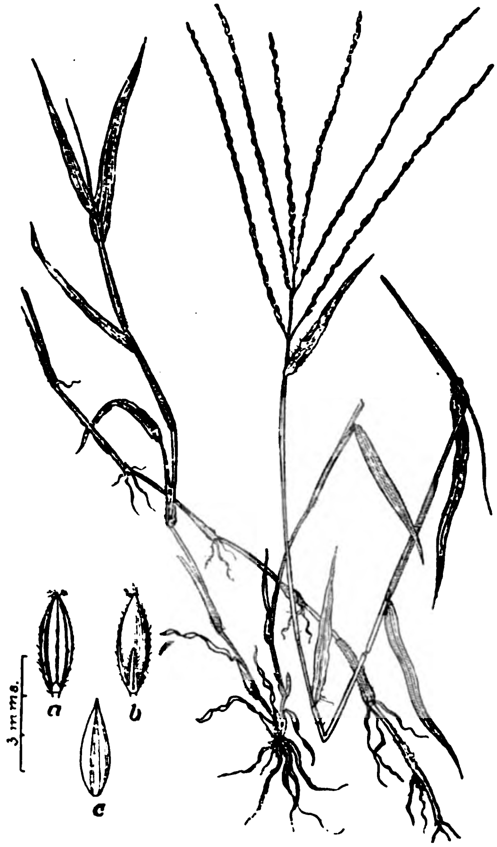


Fig. 12 (12.)

Large Crab-grass. Finger Grass. *Digitaria sanguinalis* (L.) Scop. (*Panicum sanguinale* L. *Syntherisma sanguinalis* (L.) Nash.) A spreading annual, often of a reddish hue, smooth or hairy, 30-60 cm. or more high, each stem bearing near the apex 4-15, one-sided spreading spikes, the stems usually sending out numerous tough roots at the joints. Common in gardens and often found in thin lawns and pastures. Introduced from Europe. If grass land is made rich, the better grasses and clovers will crowd this plant out or nearly so.

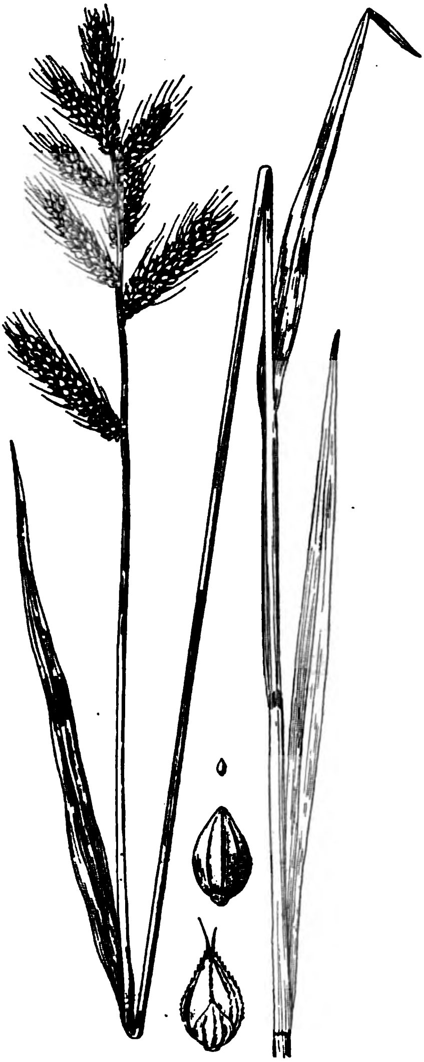


Fig. 13 (13).

Barnyard Grass. *Echinochloa crus-galli* (L.) Beauv. (*Panicum crus-galli* L.) A coarse, erect or spreading annual, 30-120 cm. high. Spikes dense, alternate, simple or compound, 2-8 cm. long bearing spikelets on two sides of a three-sided rachis. Very variable in size and color. Waste grounds especially where moist, flowering all summer. Throughout the warmer regions of both hemispheres.

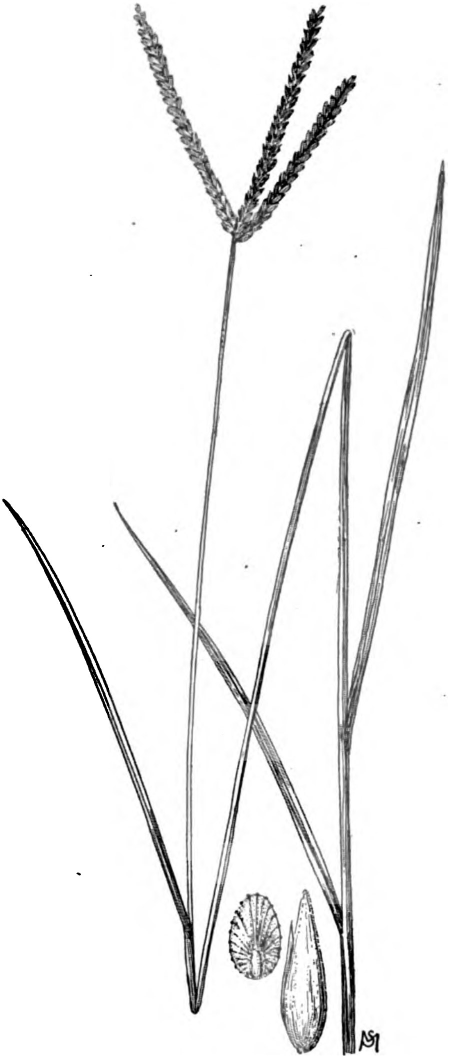


Fig. 14 (14).

Goose or **Yard-grass.** *Eleusine indica* (L.) Gaertn. A coarse, erect or spreading annual, 15-16 cm. high, each stem bearing at the apex or near it 2-5 diverging spikes, 5-7 cm. long. Rachis flattened. More common in tropical and warm temperate regions than in Michigan.

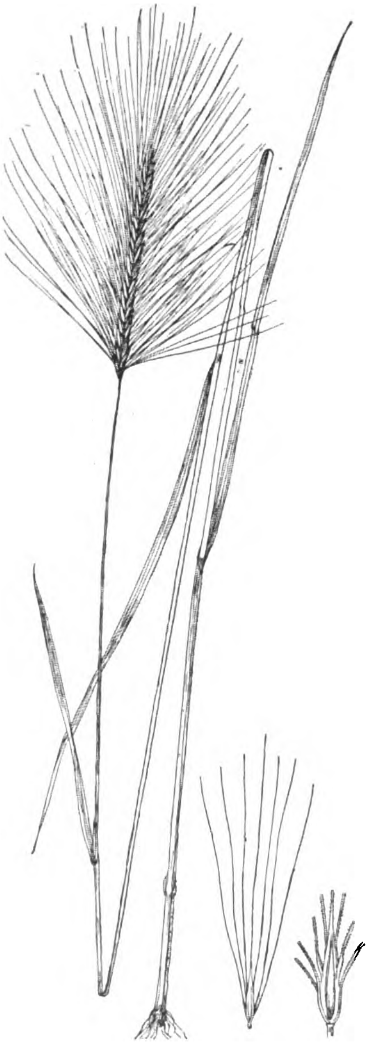


Fig. 15 (16).

Squirrel-tail Grass. *Hordeum jubatum* L. Other common names are Skunk Grass, Wild Barley. A smooth, slender, tufted annual, biennial or perennial, 30-45 cm. high. Spikes 4-7 cm. long, rachis very slender soon breaking at each joint the lower portion of which is barbed and sharp-pointed, making a formidable weapon to pierce the gums of cattle and sheep. The spikelets are three in a cluster, each with two slender awns, 4-6 cm. long. Very graceful and ornamental before the spikes break in pieces. Native of this country and widely distributed. Fortunately seldom abundant except on moist alkaline soil. It yields readily to good cultivation.

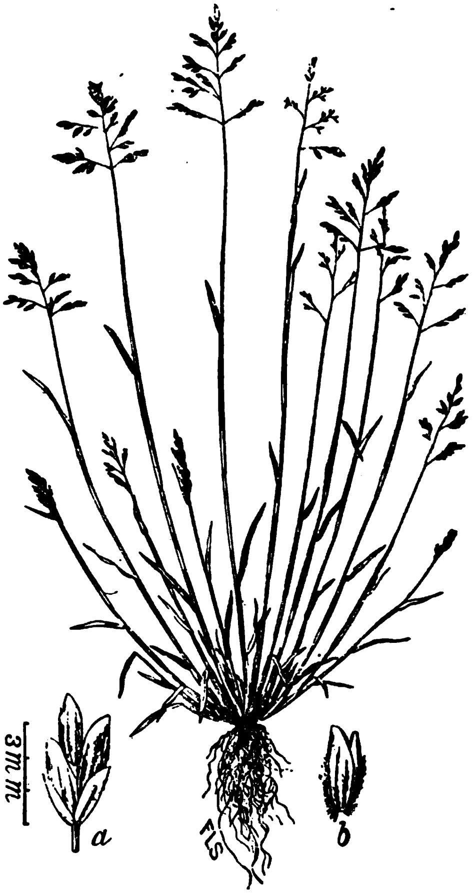


Fig. 16 (19).

Low Spear Grass. *Poa annua* L. A soft, smooth, light green annual, stems weak, compressed, 5-30 cm. high. Panicle green or purplish. This grass will produce three crops a year in central Michigan Found almost everywhere, in the vegetable garden and in a dense lawn. The enterprise of this little grass is equal to that of the English sparrow. Introduced from Europe. In shady places, where well fertilized and watered it produces a very pleasing lawn.

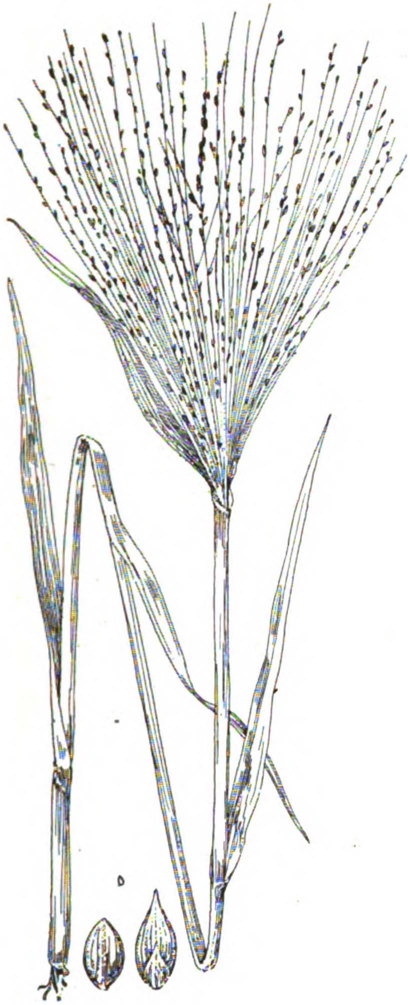


Fig. 17 (17).

Old-witch Grass. Tickle Grass. A Tumble-weed. *Panicum capillare* L. An erect, spreading, hairy, much-branched annual, 30-60 cm. high; bearing open panicles half the length of the entire plant. The branches very slender and rather stiff; the whole panicle when mature, breaking from the plant and carried for long distances by the wind. Native to this country.

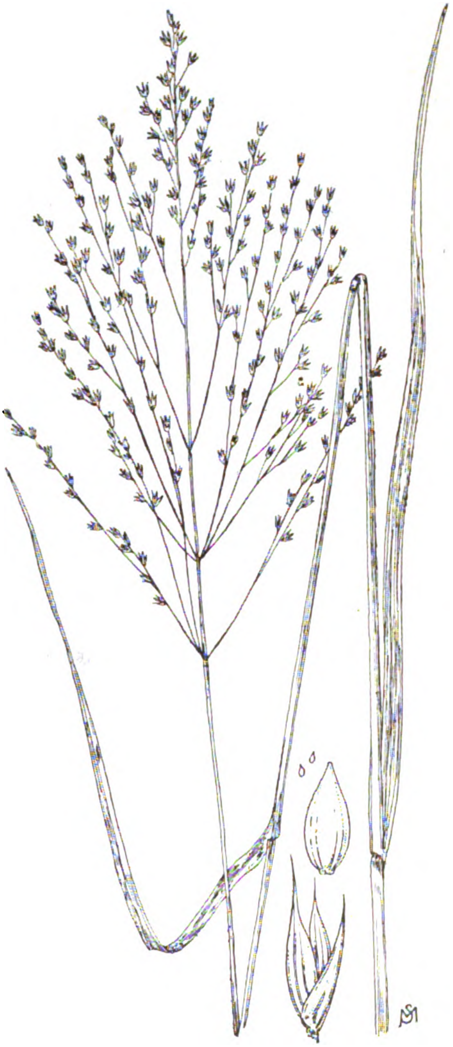


Fig. 18 (18).

Switch Grass. *Panicum virgatum* L. The stem smooth, wiry, erect, 90-150 cm. high, usually forming large tufts, with creeping strong root-stocks, long, flat leaves and ample spreading panicles, sometimes 60 cm. long. Sandy soil, usually along lakes and streams. Extensively distributed in the United States and Mexico. Rather ornamental, seldom much of a weed in Michigan.

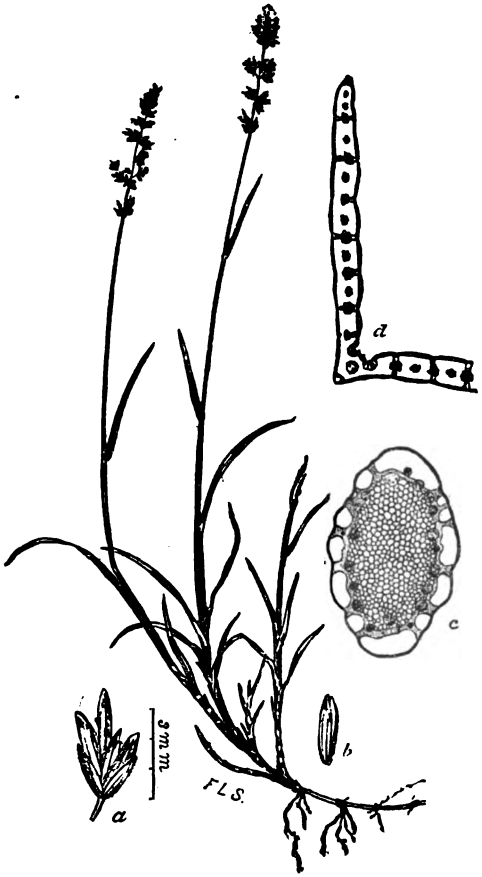


Fig. 19 (20).

Blue Grass. Flat-stemmed Poa. Wire Grass. Canadian Blue Grass. *Poa compressa* L. Bluish green, stems firm, smooth, much compressed, 30-60 cm. high from creeping rootstocks. Panicle usually contracted, 5-10 cm. long. Dry soil, extensively naturalized from Europe.

The "seeds" are sometimes used to adulterate those of June grass. Of the smaller details, perhaps the best single one to distinguish this grass from Kentucky blue grass is to be seen in figures of the spikelets, especially the palets.

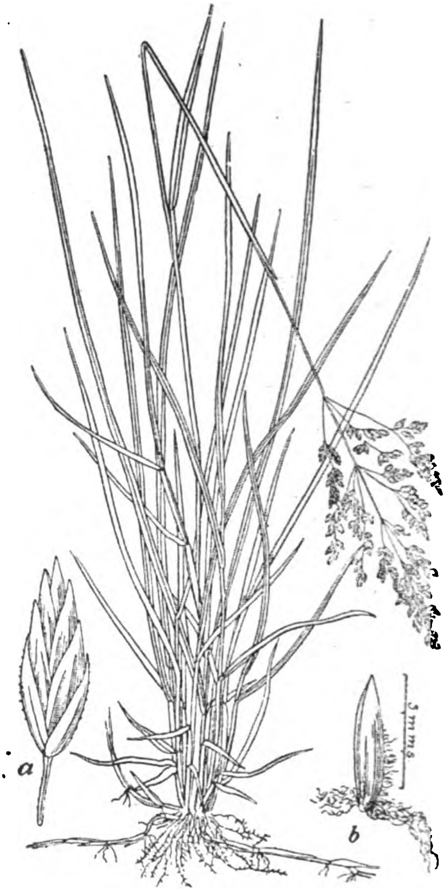


Fig. 20 (21).

June Grass. Kentucky Blue Grass. Spear Grass. *Poa pratensis* L. A very common and variable widely distributed perennial; stems smooth, scarcely compressed, 10-120 cm. high, from copious running rootstocks; blades more or less compressed unless moist, 5-30, rarely 60-150 cm. long, the edges usually parallel, the apex very abruptly boat-shaped; panicle when open about as wide as high. Very extensively distributed in Europe, Asia, North and South America.

Our plants in cultivation introduced from Europe. This is one of our worst weeds for the garden and low moist fields in cultivation.

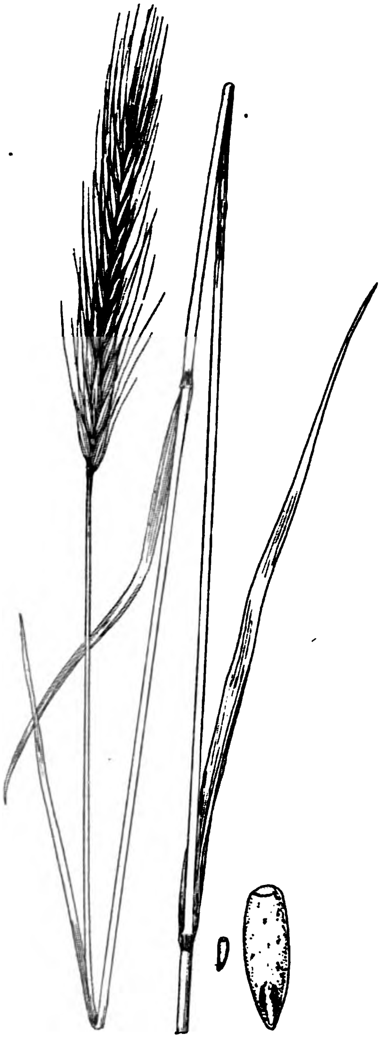


Fig. 21 (22).

Rye. *Secale cereale* L. An erect, glaucous fall annual, 1-2 m. high. Spikelets usually two-flowered, in a cylindrical spike, sessile, compressed, one at each joint on alternate sides of the rachis. A hardy plant, often a weed in fields of wheat. Introduced from Europe.

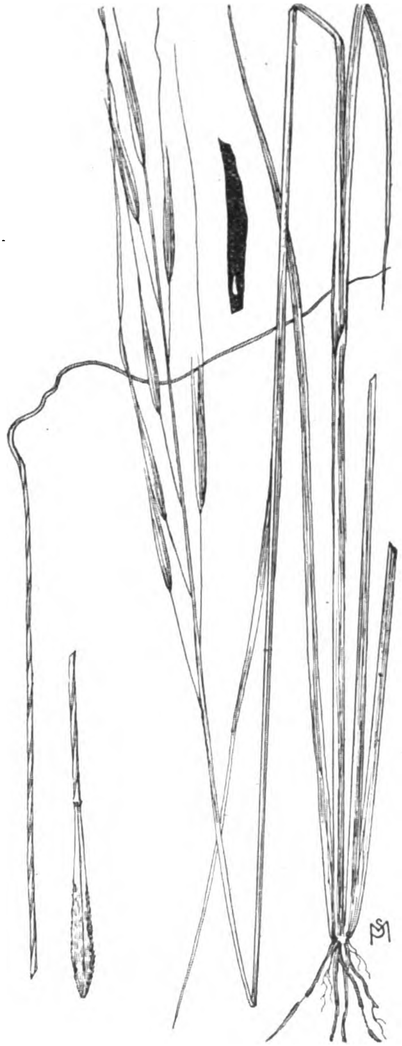


Fig. 22 (25).

Porcupine Grass. *Stipa spartea* Trin. A graceful, erect, tufted perennial, 50-120 cm. high. Leaves narrow, long acuminate, panicle few-flowered, 12-15 cm. long. Rather scarce in Michigan. A pernicious weed, on account of its barbed "seeds."

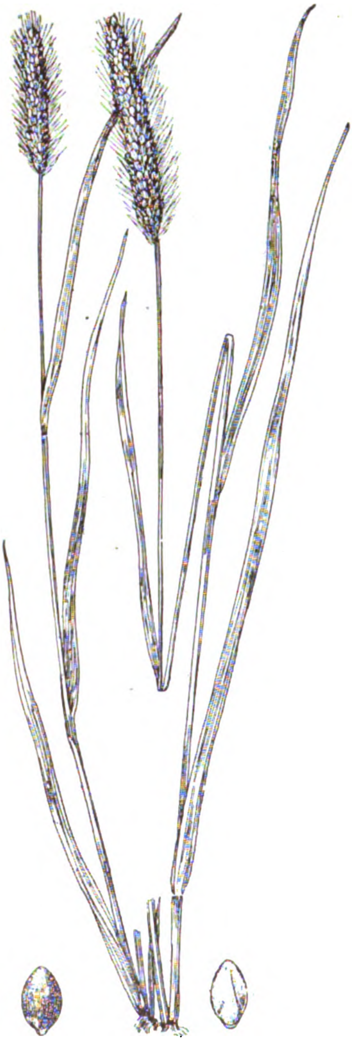


Fig. 23 (24).

Pigeon Grass. Green Foxtail. *Setaria viridis* (L.) Beauv. (*Chaetochloa viridis* (L.) Nash.) Stems erect, 30-60 cm. high. Sheaths not compressed, not tinged with red; blades flat, not twisted. Spike-like panicle erect, green, nearly cylindrical, 3-8 cm. long, bristles for each spikelet 1-5, often 10 mm. long, barbed upwards. Very common in cultivated fields, oftener met with in clover seed than any other weed. It much resembles small plants of Hungarian grass; naturalized from Europe.

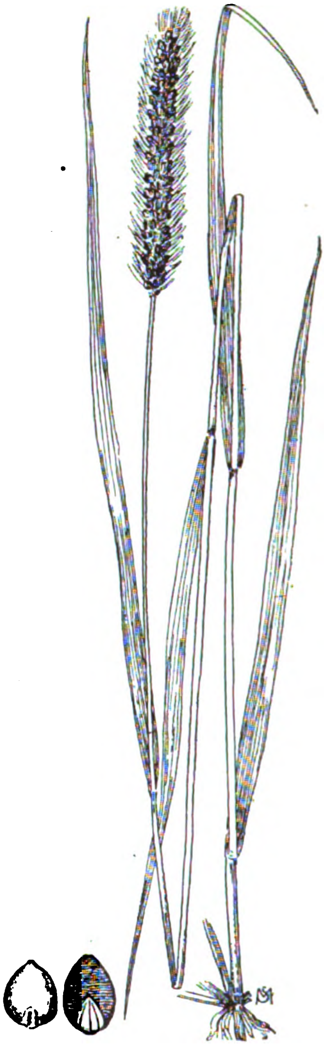


Fig. 24 (23).

Pigeon Grass. Yellow Foxtail. *Setaria glauca* (L.) Beauv. (*Chaetochloa glauca* (L.) Scrib.) Stems erect, compressed below, 30-60 cm. high; sheaths loose, compressed, more or less tinged with red; blades flat twisted. Spike stiff, simple, cylindrical usually tawny yellow, 5-10 cm. high, awn-like branches, 6-13, barbed upwards.

A common annual weed found in cultivated ground and waste places in many regions of the world. It starts much later than our other species of pigeon grass, *S. viridis*. Introduced from Europe.

SEDGE FAMILY. CYPERACEAE.

A large family of grass-like or rush-like plants including about 3,000 species widely distributed over the world, nearly all of which are of little or no value to the farmer. Most of them thrive in marshes or on wet land. The leaves of sedges are placed one above or within the other on three sides of the stem, while the leaves on a straight stem of a grass plant are placed on two sides of the stem. Some sedges are cut and cured making hay of very poor quality, known as marsh hay.

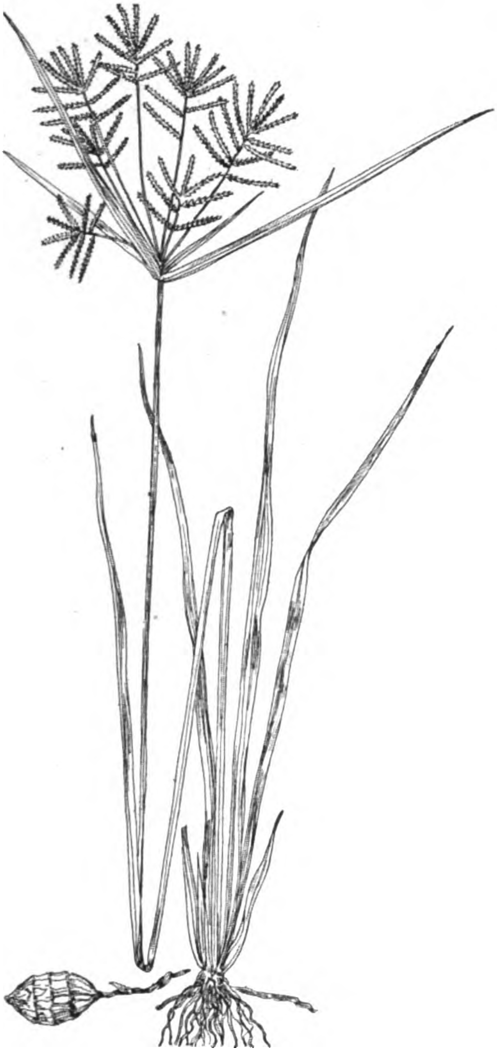


Fig. 25 (26).

Yellow Nut Grass. *Cyperus esculentus* L. Sedges are very difficult of identification except by an expert. The cut gives a good idea of the top of a moderate sized plant, 30-70 cm. high. Perennial by rootstocks bearing tubers, one shown in the figure at b. Sometimes troublesome on low land. Remedy for the destruction of most all sedges is thorough drainage of the land.

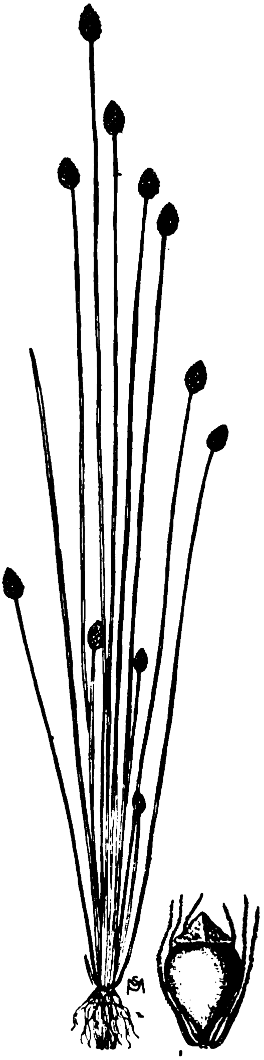


Fig. 26 (27).

Ovoid Spike Rush. *Eleocharis ovata* (Roth.) R. & S. A slender, tufted annual, 6-40 cm. high; each stem bearing at its base several short leaf sheaths and at top a single egg-shaped spike, 2-7 mm. long. Very variable. Sometimes troublesome in wet land, as are also to some extent several other species much resembling this one, except in size and shape of the spike. Widely distributed. To get rid of it, drain the land.

RUSH FAMILY. JUNCACEAE

This is a small family containing about 200 species of grass-like and sedge-like plants widely distributed, growing in tufts in moist land. (Fig. 27.)

LILY FAMILY. LILIACEAE.

Most people have some conception of the meaning of the word lily, though they may not recognize onions as members of the family. The world over there are 1,300 species in a restricted sense or nearly 1,900 in the broader sense. Botanists are not all agreed on this point.

Some people would rank leeks found in the woods in early spring as weeds, because they taint milk from which butter is made, though a few people like leeky butter. (Fig. 28.)

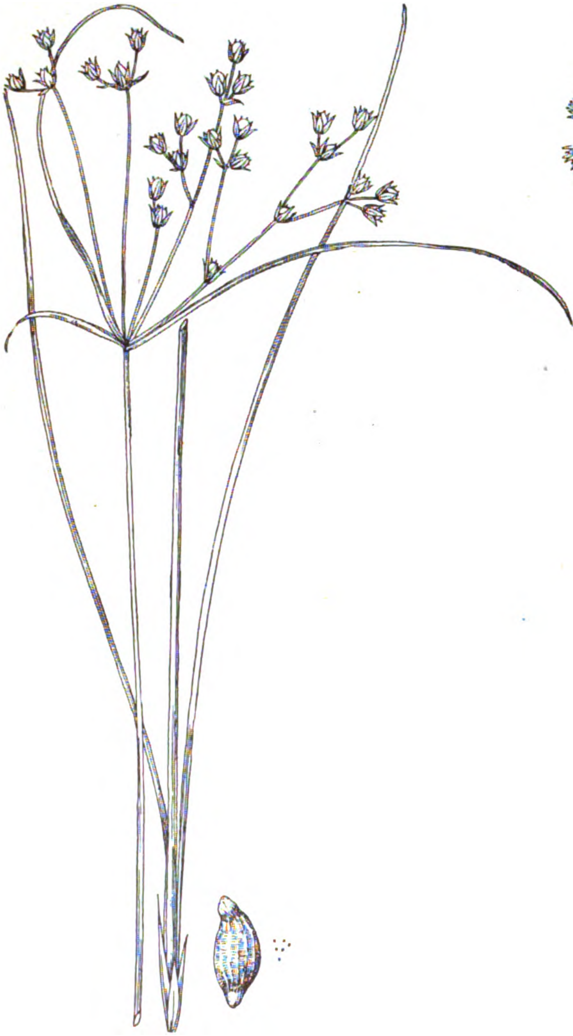


Fig. 27 (28).

Slender Rush. *Juncus tenuis* Willd. A small plant, 15-40 cm. high; stem wiry; the lower leaves about half as high as the stem; some of the upper leaves projecting above the flowers.

In dry or moist soil, especially along roads and paths, now spreading extensively in many regions. Seldom recognized.

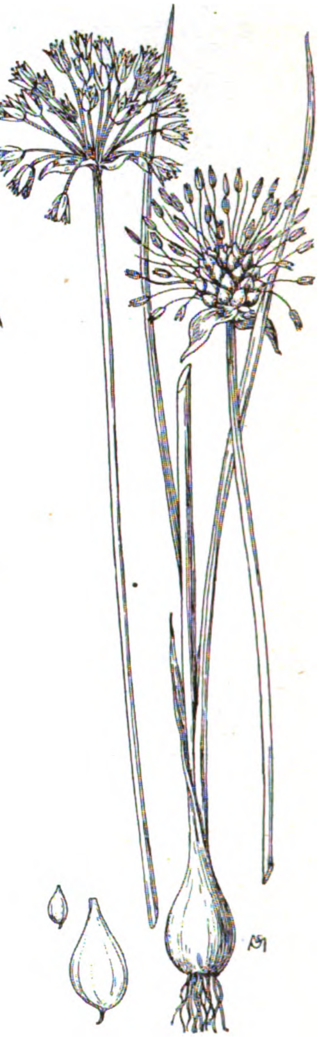


Fig. 28 (29).

Field Garlic. Wild Garlic. Wild Onion. *Allium vineale* L. Like some other species this one not only produces bulbs in the ground, but in place of flowers at the top it has acquired the habit of producing bulblets more or less. The hollow stems are slender, a few in a bunch, 30-90 cm. high. Field garlic is slowly extending its domain into grass land and fields of wheat and is killed with much difficulty. The bulblets are about the size of kernels of wheat, and on this account are sometimes sown with seed wheat or ground in with the flour.

NETTLE FAMILY. URTICACEAE.

There are about 475 species of nettles and nearly related plants of wide distribution, mostly insignificant in appearance and economic value; all of them herbs, or, as some join the elms and mulberries with the nettles, the family then contains about 1,550 species.

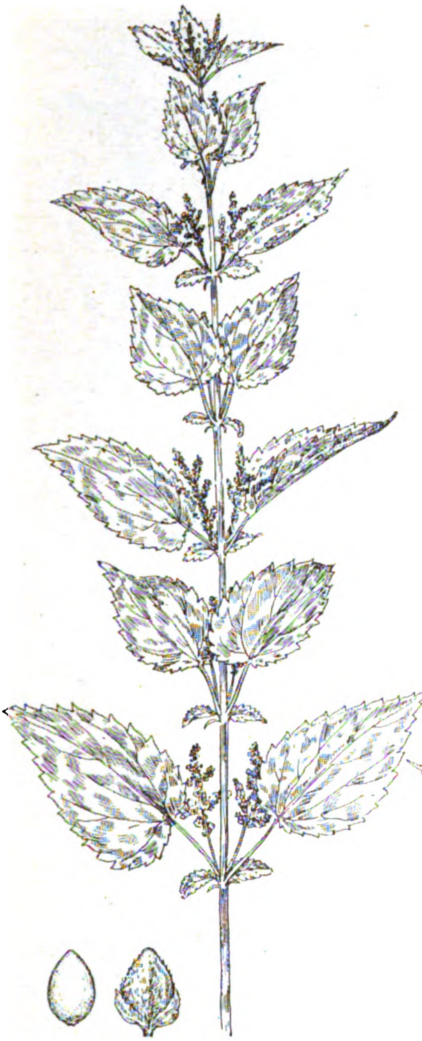


Fig. 29.

Stinging Nettle. Great Nettle. *Urtica dioica* L. A rather stout, vigorous, stinging perennial, 60-90 cm. high; leaves ovate, heart-shaped, apex acuminate; flower clusters large, much branched, mostly dioecious. Waste places. Lansing, Bay City, Manistee. Introduced from Europe.

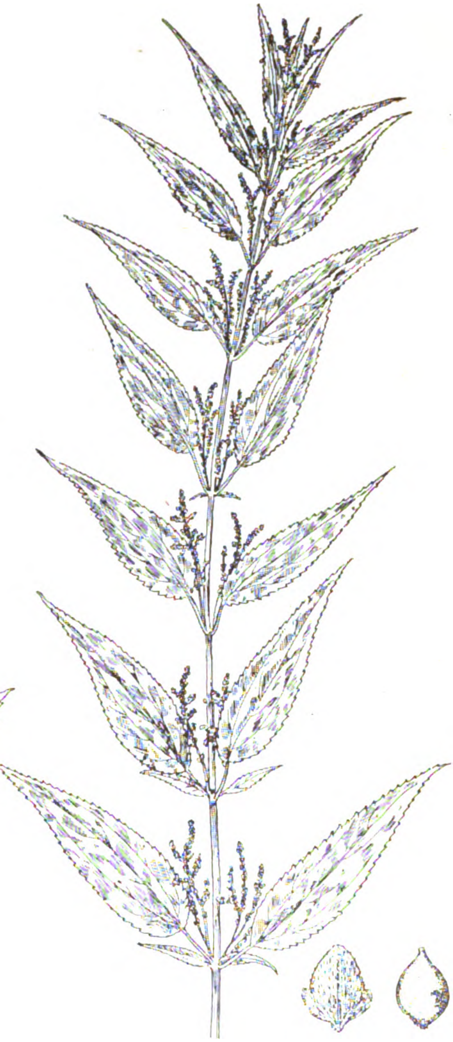


Fig. 30 (30).

Slender Nettle. *Urtica gracilis* Ait. A slender perennial, sparingly branched, 30-180 cm. high, armed with stinging hairs; leaves narrow, 5-10 cm. long. Moist soil, common.

BUCKWHEAT FAMILY. POLYGONACEAE.

Mostly herbs with entire leaves and stipules in the form of sheaths extending around the stem; flowers with a calyx more or less persistent; ovary one-celled, becoming an achene in fruit, flattened or 3-4- angled. Among its 800 species the family contains few of economic importance, but is rather conspicuous for the weeds it affords. Here are sorrels, docks, knotweeds, smartweeds and others.

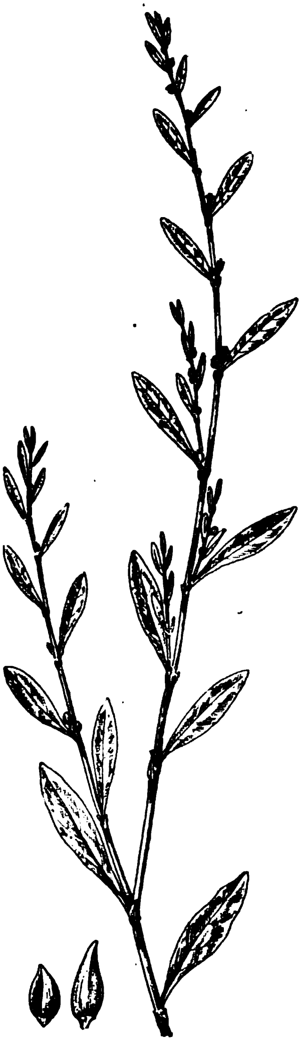


Fig. 31 (31).

Knot-grass. Door-weed. *Polygonum aviculare* L. A slender, prostrate or erect annual (perennial farther south), dull or bluish green in color, usually less than 30 cm. high; leaves small; flowers small, inconspicuous; fruit a triangular achene, dull, minutely granular and striate. Common along paths and about door yards. Native to this country, Europe and Asia.

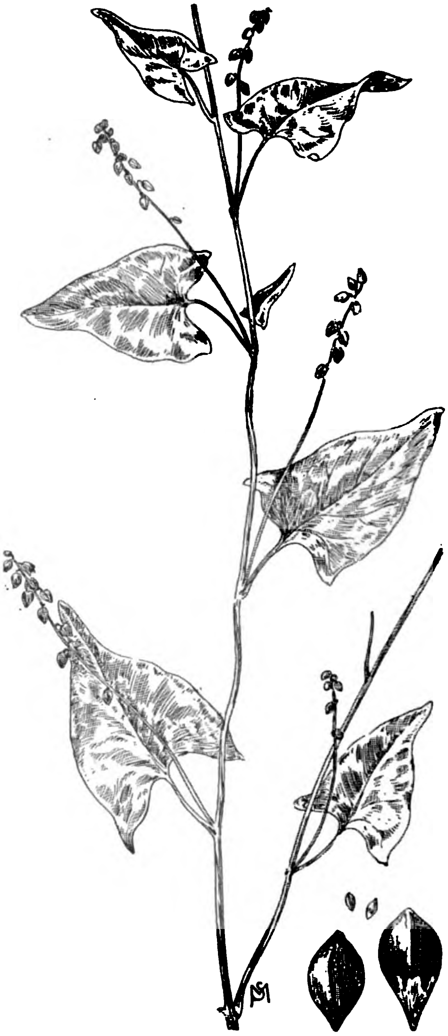


Fig. 32 (32).

Wild Buckwheat. Black Bindweed. *Polygonum Convolvulus* L. An annual, twining or trailing vine, 10-90 cm. or more long; leaves heart-shaped or halberd-shaped, pointed; flowers greenish in slender, interrupted racemes; fruit three-angled, dull, black; in cultivated annual crops. Introduced from Europe.

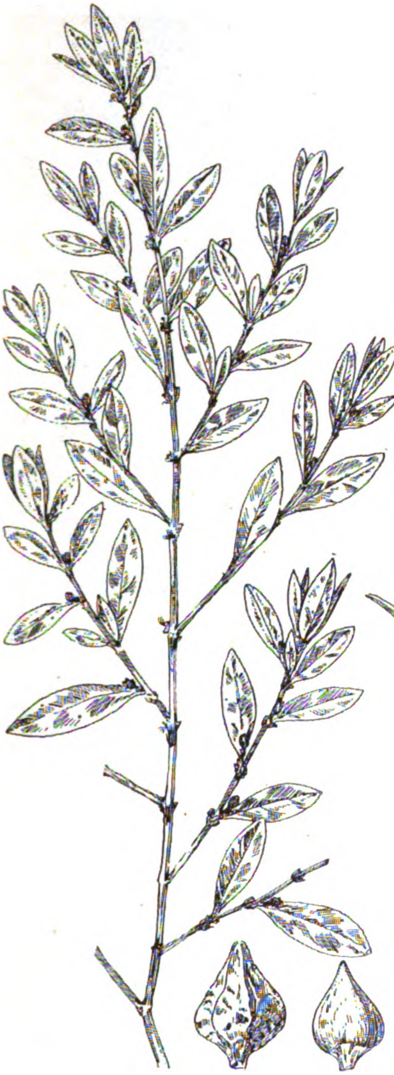


Fig. 33 (33).

Erect Knotweed. *Polygonum erectum* L. Annual, smooth, stem erect, usually simple; leaves oval, obtuse, 13-60 mm. long; flowers yellowish-green.

When compared with *P. aviculare*, it is taller with larger leaves and larger fruit. Seldom a weed of any importance; native of this country.

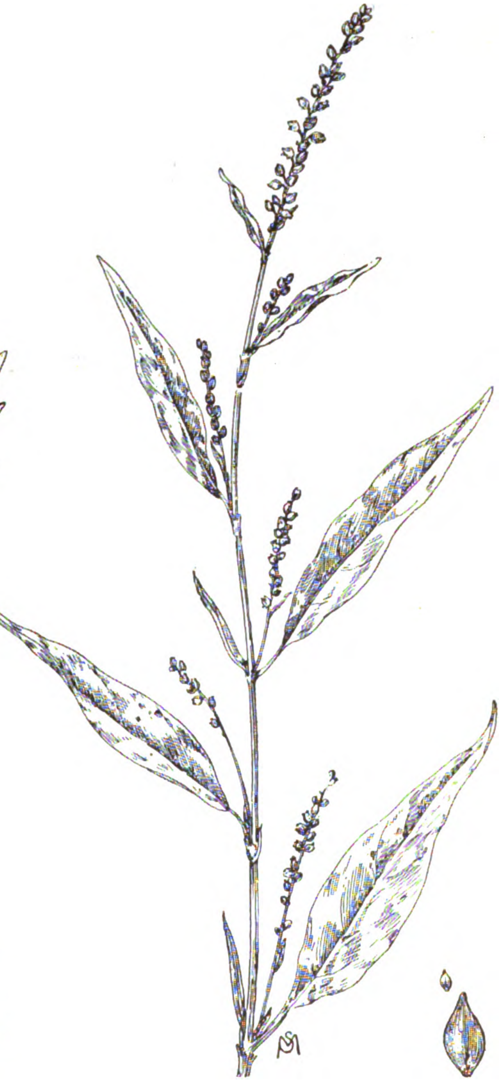


Fig. 34 (34).

Smart-weed. *Polygonum Hydropiper* L. A smooth, reddish, peppery, erect or spreading annual, 30-60 cm. high; leaves narrow, 2-8 cm. long; spikes nodding, interrupted, as long as the leaves; flowers mostly greenish; achene 2-3-sided, dull, granular. Wet land; introduced from Europe into this section; possibly indigenous in the northwest.

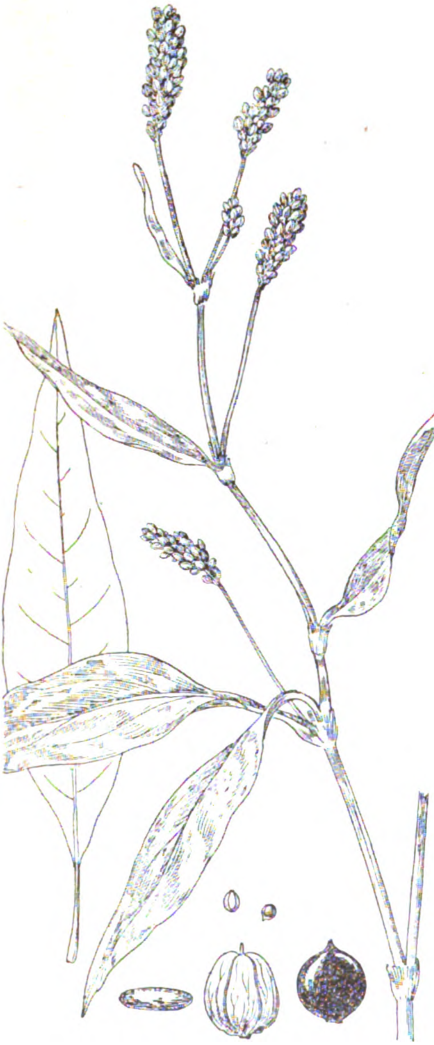


Fig. 35 (36).

Pennsylvania Persicaria. *Polygonum pennsylvanicum* L. Annual, smooth below, erect, simple or branched, 30-90 cm. high; peduncles and pedicels glandular; leaves lanceolate; racemes 2-4 cm. long; flowers bright rose-color; achenes flattened, nearly circular, jet black, about 3 mm. long. Moist soil; native to this country, Canada and the eastern United States.

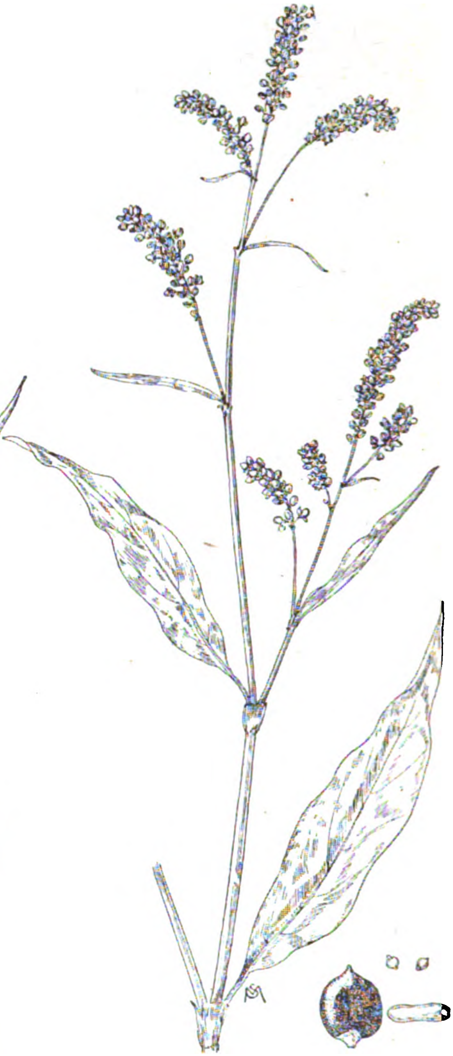


Fig. 36 (35).

Pale Persicaria *Polygonum lapathifolium* L. Annual, smooth, the pedicels glandular, branching, 60-240 cm. high; leaves lanceolate, 4-20 cm. long; spikes slender, rather dense, drooping, 1-5 cm. long, achenes flattened, shining; wet places, common, very variable, throughout temperate North America. Introduced from Europe.

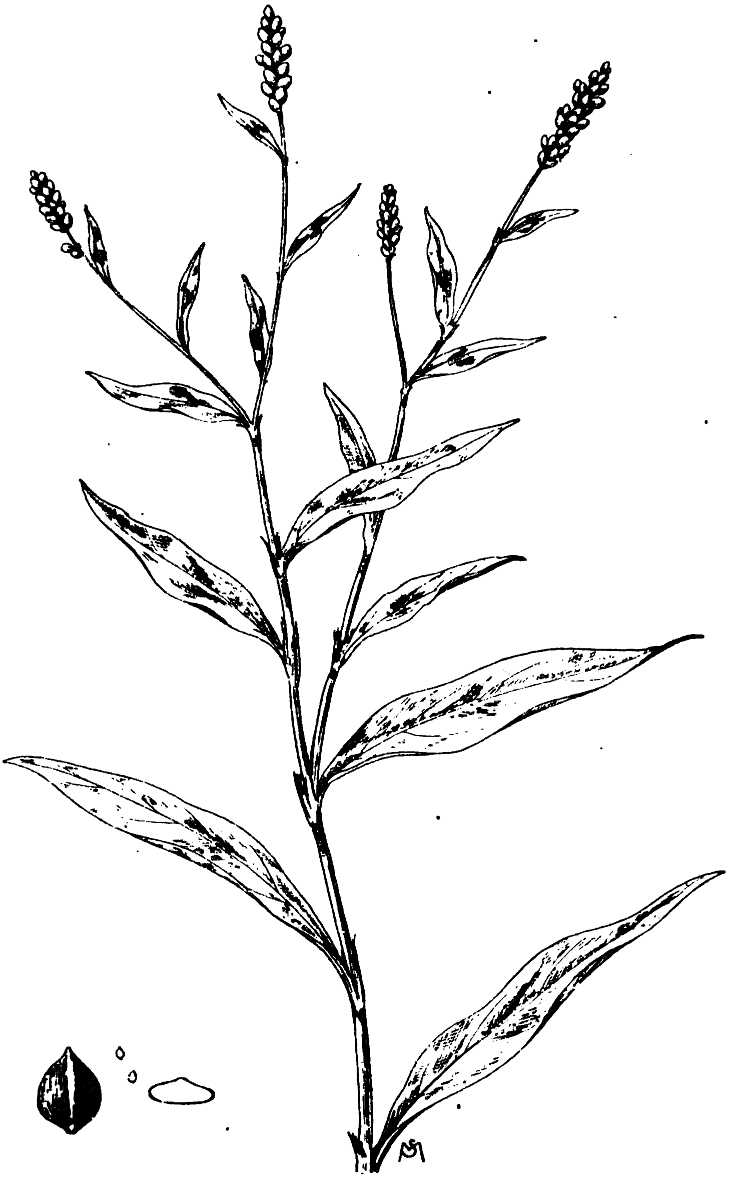


Fig. 37 (37).

Lady's Thumb. *Polygonum Persicaria* L. Annual, usually smooth, much branched unless crowded, 15-60 cm. high; leaves lanceolate, roughish, often marked by a dark triangular or moon-shaped spot near the middle, giving rise to the common name; racemes dense, 2-3 cm. long; calyx pink to dark purple; achenes smooth, shining, usually flattened, 2-3 mm. long. Fields and waste places very common. Introduced from Europe and widely distributed.

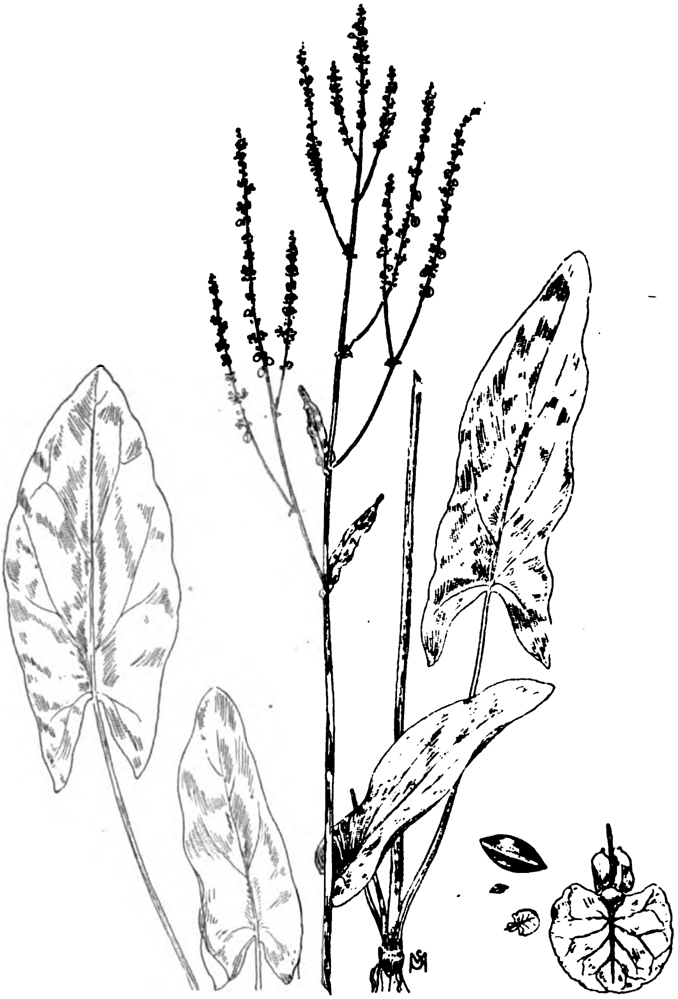


Fig. 38 (29).

Tall Sorrel. Sour Dock. *Rumex Acetosa* L. An erect, sour, smooth, dioecious perennial, 30-90 cm. high; spreading by rootstocks, leaves oblong, arrow-shaped, 2-10 cm. long; racemes erect, crowded or interrupted, calyx green, winged in fruit, orbicular, heart-shaped, 3.5-4.5 mm. long. Sparingly naturalized from Europe.

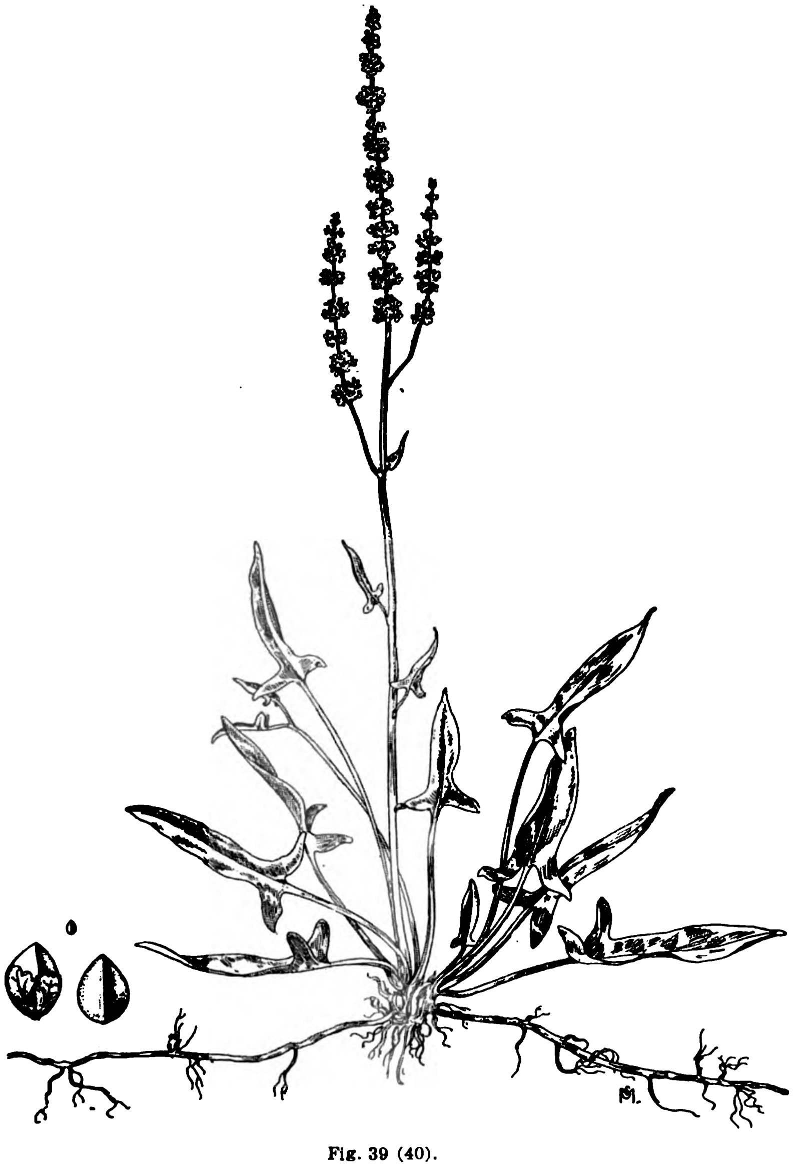


Fig. 39 (40).

Sheep Sorrel. Red-topped Sorrel. Field Sorrel. *Rumex Acetosella* L. 'An erect, sour, dioecious annual or perennial, spreading by running rootstocks, 10-30 cm. high; leaves mostly narrowly hastate, usually widest above the middle; flowers in erect, interrupted racemes.

Widely distributed throughout most of North America. Mostly introduced from Europe. In many places a common weed, though it is very scarce in cultivated land of the college farm.

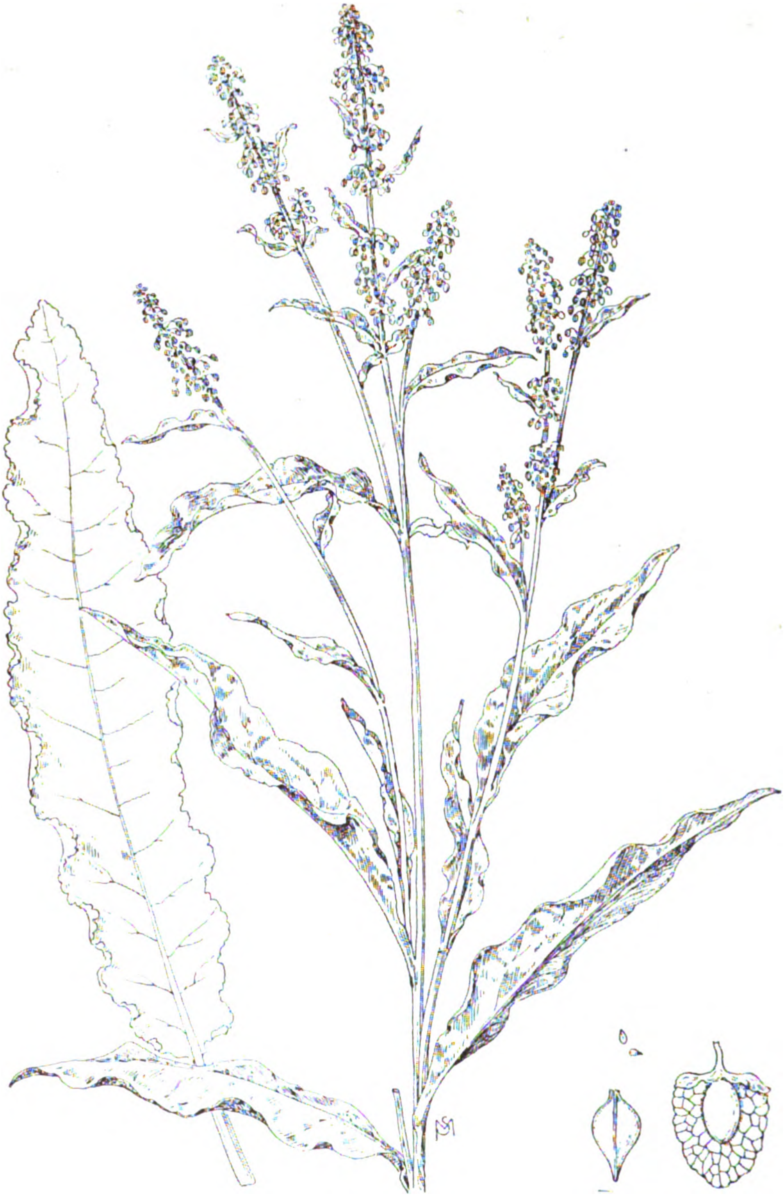


Fig. 40 (41).

Narrow-leaved Dock. Curled Dock. *Rumex crispus* L. Perennial with a deep tap root smooth, rather slender, erect, 90-160 cm. high; leaf-blades cordate, lanceolate, acute, with wavy-curled margins; panicle rather open; flowers rather loosely whorled, valves circular, heart-shaped, nearly entire, 2.5-3.5 mm. long, each bearing a tubercle. Very common and well known as a bad weed. Introduced from Europe. Not difficult to manage with a good rotation of crops. When it appears in a meadow, wait till the stem runs up and gets some strength, before seeding. When the ground is soft, thrust a spade erect near the plant, prying with spade and pulling with the other hand and out comes all the main root.

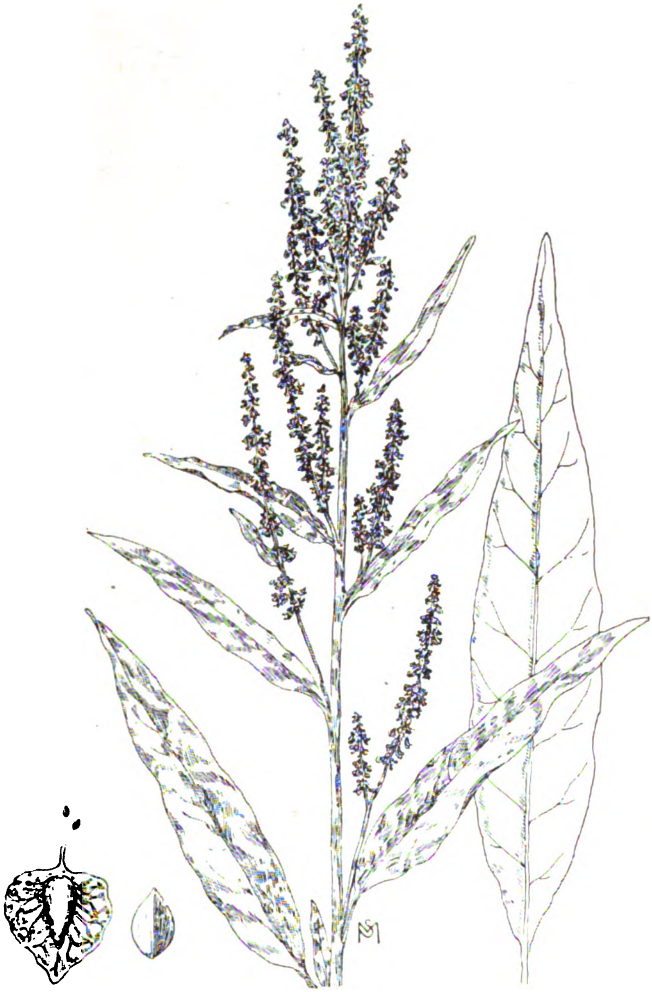


Fig. 41 (44).

Willow-leaved Dock. *Rumex mexicanus* Meisn. (*R. salicifolius.*) A smooth, light green, erect, perennial, 30-90 cm. high, with a strong tap root; leaves linear-lanceolate; panicle very dense; calyx deltoid-ovoid; about 3 mm. long; tubercles three, large; achene dark red, shining. Native of North Eastern North America. Widely distributed, not yet common in Michigan.

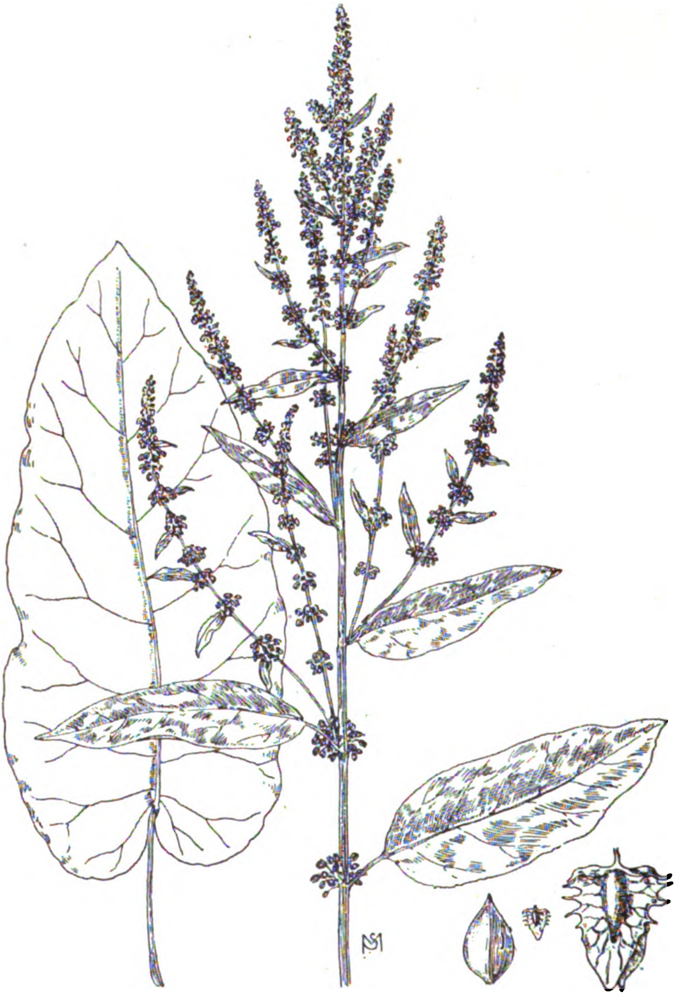


Fig. 42 (42).

Broad-leaved or **Bitter Dock.** *Rumex obtusifolia* L. A smooth perennial, with a deep tap root; stem simple, stout, erect, 60-120 high; lower leaves heart-shaped, oblong-lanceolate, the upper narrower, the margins only slightly wavy; flowers loosely whorled, valves (part of calyx) ovate-hastate, with some teeth on the sides near the base, the larger tubercle ovoid-elliptical, the other two rudimentary; achene dark red, smooth, shining. Fields and roadsides, less common than *R. crispus*. Introduced from Europe and widely distributed.

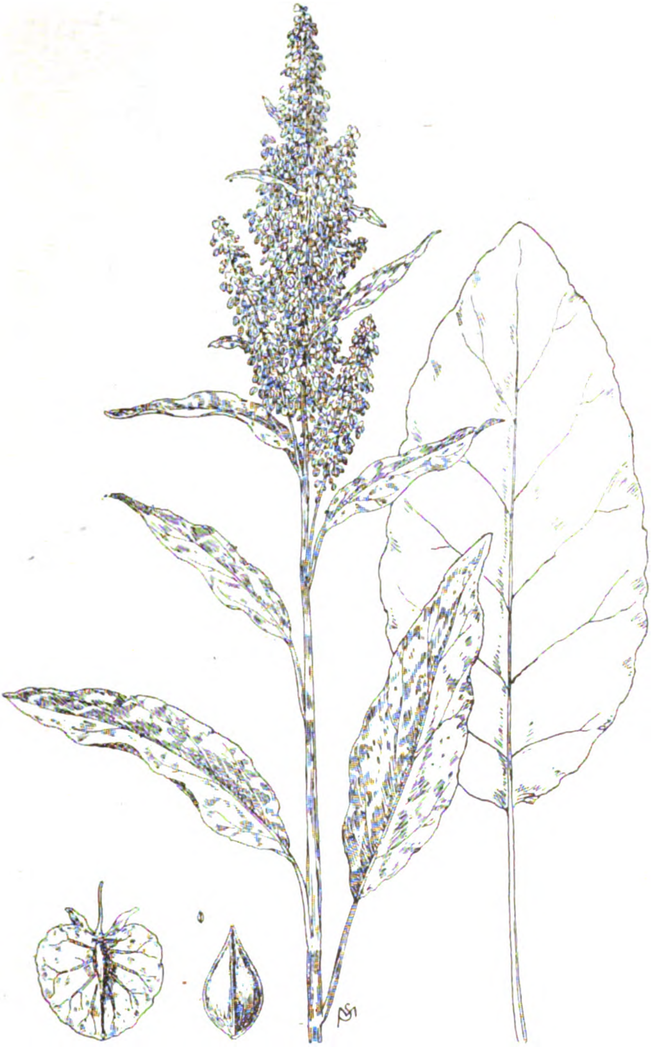


Fig. 43 (43).

Patience Dock. *Rumex patientia* L. A tall, erect, perennial from a stout tap root, 60-150 cm. high; lower leaves ovate-lanceolate, long-petioled, 80-30 cm. long, the upper narrower; panicle dense, whorled; wings cordate, nearly entire, 4-9 mm. long, one tubercle, 2-3 mm. long, ovoid, the other two wanting or rudimentary. Becoming common; naturalized from Europe.

GOOSEFOOT OR PIGWEED FAMILY. CHENOPODIACEAE.

Chiefly annual herbs, of weedy aspect so far as this country is concerned; flowers very inconspicuous, each pistil bearing a single seed. Economic plants are spinach and beets. A small family of 550 species widely distributed.

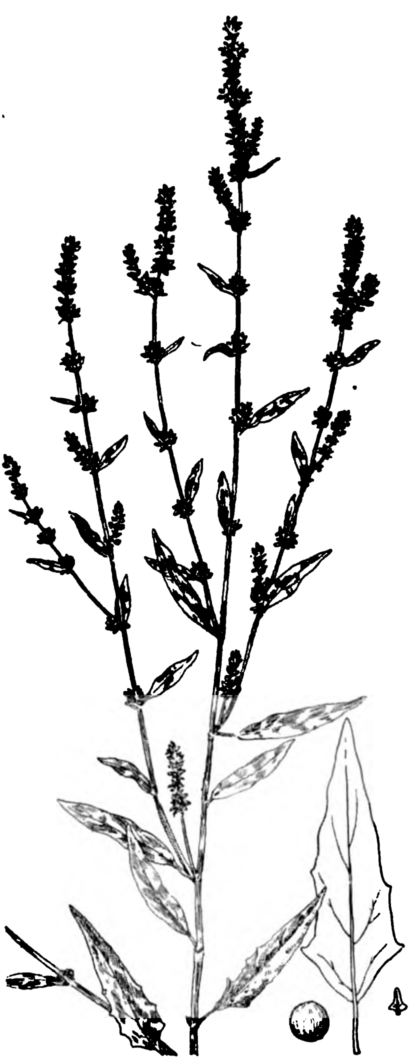


Fig. 44 (45).

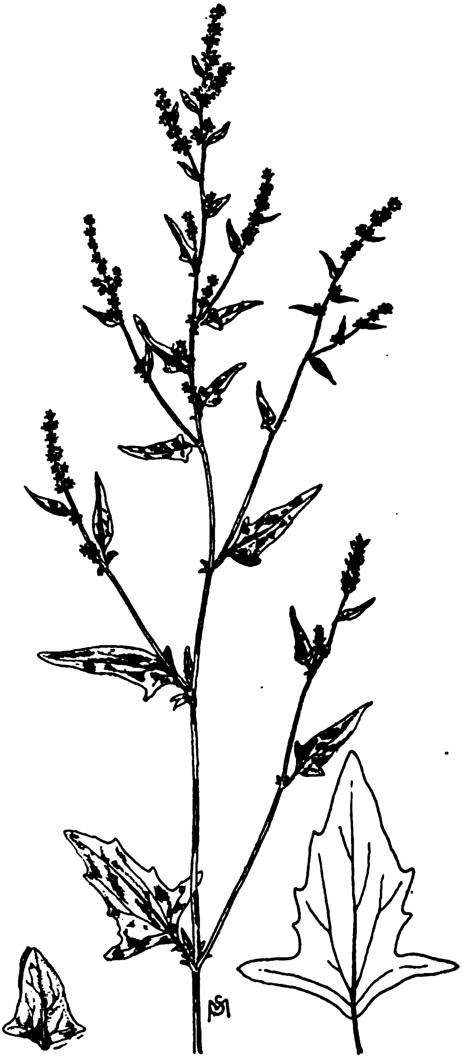


Fig. 45.

Spreading Orache. *Atriplex patula* L. A dark green, spreading annual 30-120 cm. high; leaves petioled, the blades narrowly lanceolate-hastate, 2-10 cm. long, sparingly toothed or three-lobed below; flower clusters in rather slender spikes, the two kinds together or separate. Naturalized from Europe. Not common nor troublesome.

Halberd-leaved Orache. *Atriplex patula hastata* (L.) Gray. A pale green or purplish, scurfy annual, 30-70 cm. high; leaves with slender stems, the blades of the lower broadly triangular-hastate, entire or sparingly toothed; very variable. Salt meadows and waste places along the Great Lakes. Not very troublesome.

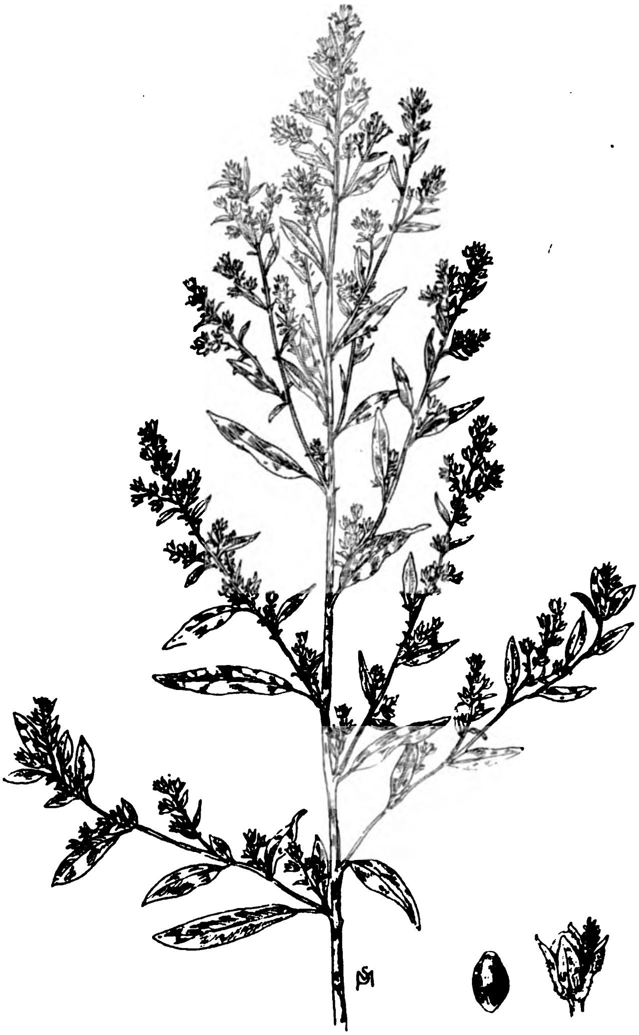


Fig. 46.

Russian Pigweed. *Axyris amarantoides* L. A coarse, erect, branching, very leafy annual, 60-120 cm. high, clothed with short, star-shaped hairs, turning white with maturity.

Not yet known in Michigan but should be diligently looked for. Found near Winnipeg, Canada, as imported from Russia and is spreading rapidly.

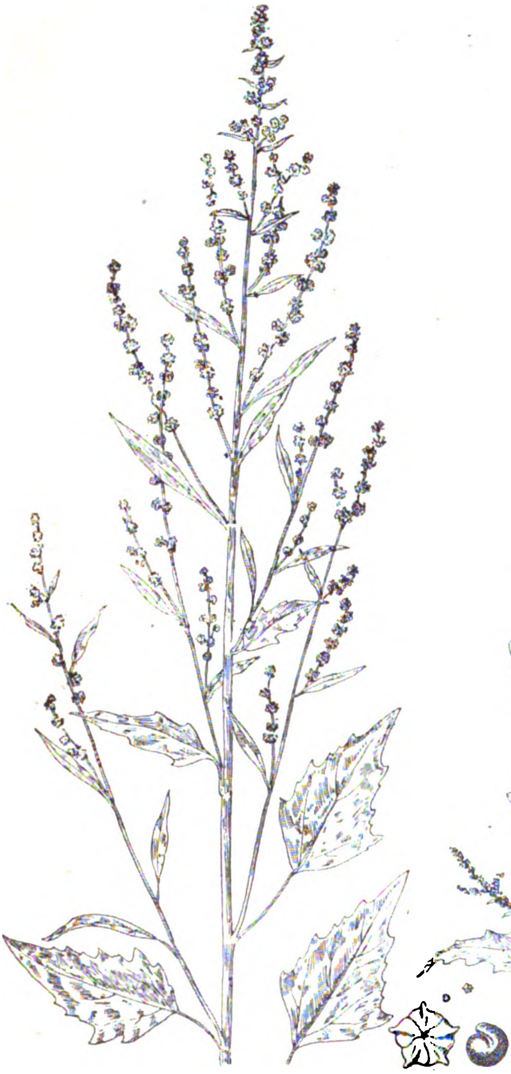


Fig. 47 (46).

Pigweed. Lamb's Quarters. *Chenopodium album* L. Annual, pale green, branching much, 30-300 cm. high; leaves varying from rhombic-ovate to lanceolate, the lower more or less sinuate-lobed or toothed; flower clusters dense, simple or compound. Introduced from Europe and widely distributed in North America. One of our commonest weeds everywhere in annual crops. A variety, *viride* is bright green, less mealy and has less dense inflorescence, found with the above.

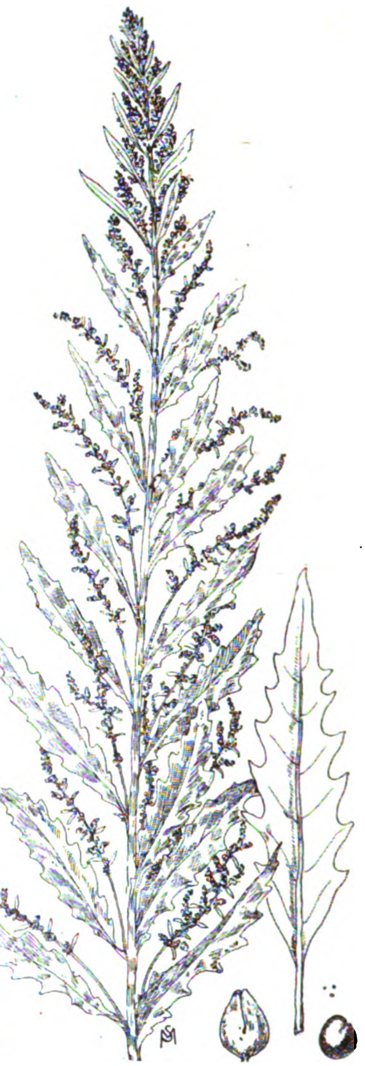


Fig. 48 (47).

Mexican Tea. *Chenopodium ambrosioides* L. A smooth or slightly glandular, not mealy, strong-scented, leafy annual, 60-90 cm. high; leaves with short stems, oblong-lanceolate, entire or wavy-toothed, spikes leafy, densely flowered. Naturalized from tropical America and widely distributed. Not prominent in Michigan.

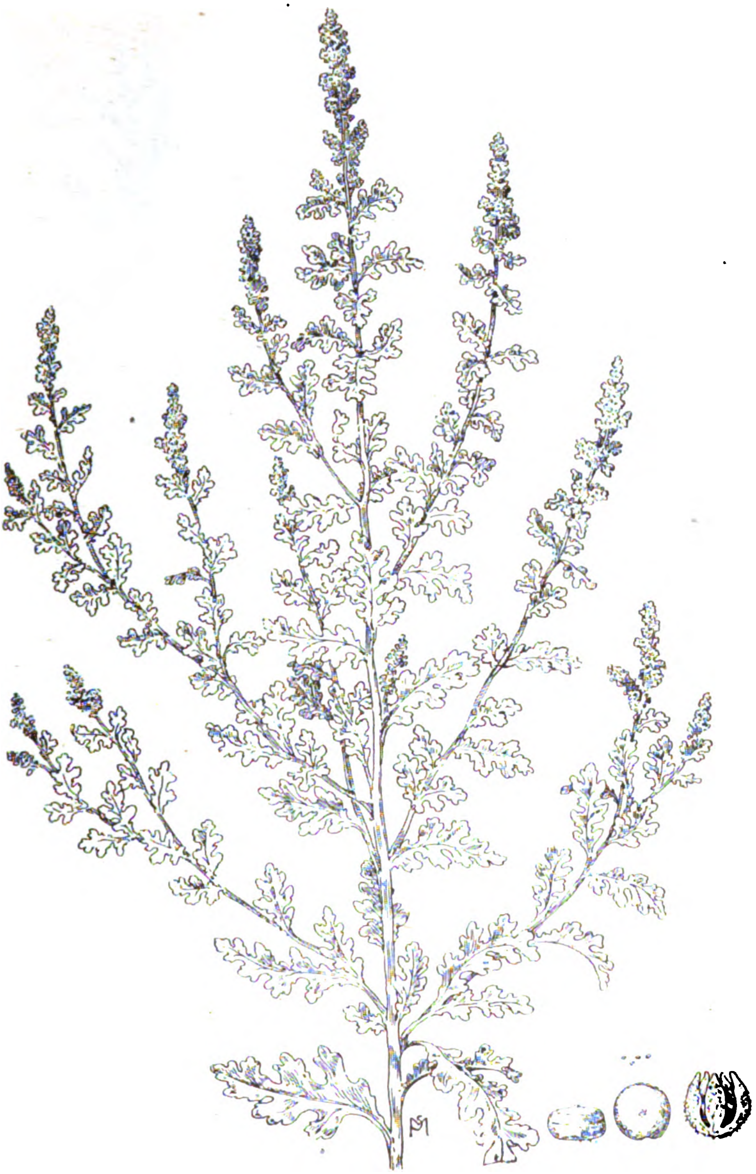


Fig. 49 (48).

Jerusalem Oak. *Chenopodium Botrys* L. Annual, glandular, pubescent, viscid, strong-scented, 20-60 cm. high; leaves oblong, pinnatifid, 2-4 cm. long; racemes cyme-like, loose, leafless; flowers very small. Waste places, extensively spread, coming from Europe; not prominent in Michigan.

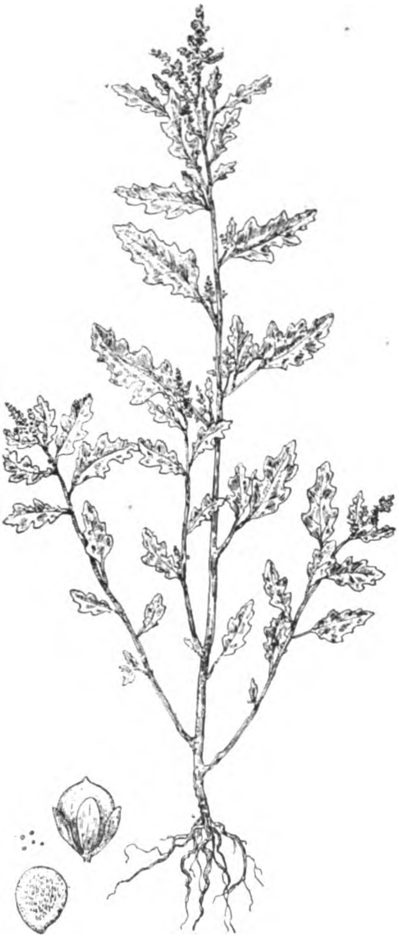


Fig. 50 (49).

Oak-leaved Goosefoot. *Chenopodium glaucum* L. Annual, spreading, 8-30 cm. high; leaves pale green above, white-mealy below, mostly oblong, sinuate-dentate, 24 cm. long; spikes small axillary. Often found in waste places over much of the globe, coming to this country from Europe.

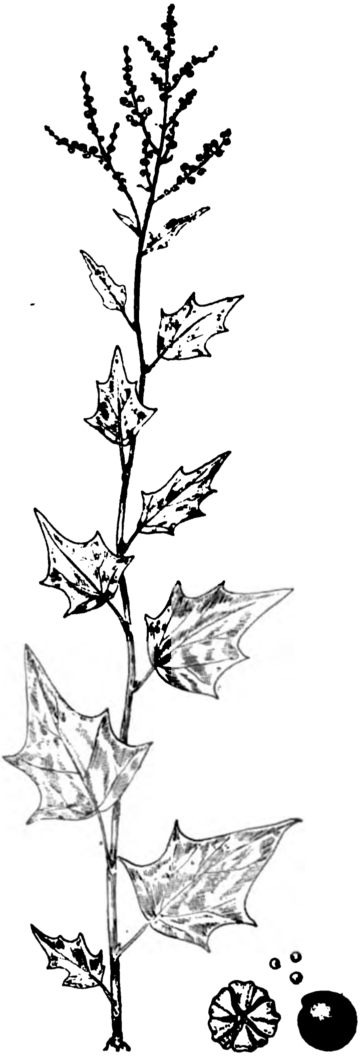


Fig. 51 (50).

Maple-leaved Goosefoot. *Chenopodium hybridum* L. Annual, bright green, not mealy, 30-120 or more high; leaves thin, cordate, often ovate-rhombic, the lower, 8-15 cm. long, taper pointed, 1-4 large teeth on each side; racemes loosely panicled, leafless. Native to North America and Europe. Not a prominent weed in Michigan.

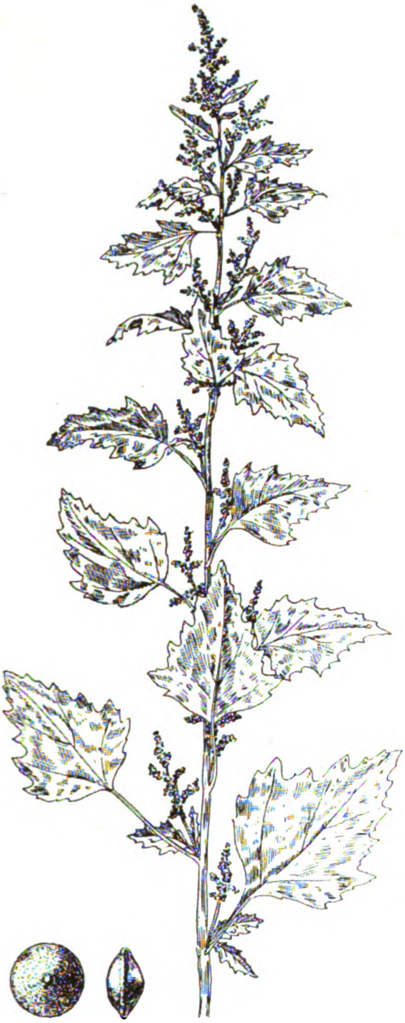


Fig. 52.

Nettle-leaved Goosefoot. *Chenopodium murale* L. Annual, scarcely mealy, loose, branched, 30-60 cm. high; leaves bright green with petioles, blades rhombic-ovate, coarsely and sharply toothed, 4-8 cm. long; spikes in loose axillary panicles. Widely distributed, coming from Europe. Not prominent in this state.

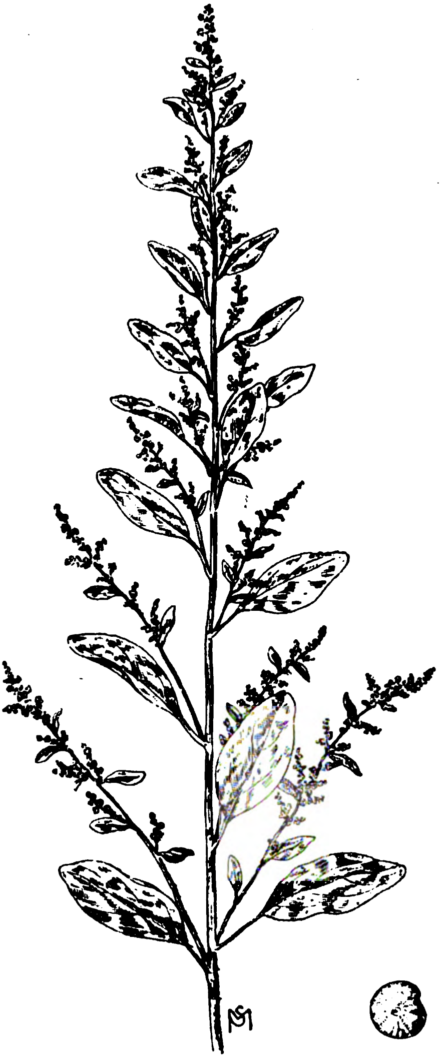


Fig. 53 (51).

Many-seeded Goosefoot. *Chenopodium polyspermum* L. Annual, not mealy, usually much-branched, 15-90 cm. high; leaves petioled, entire, mostly oblong, 2-6 cm. long; slender panicles abundant, calyx not completely covering the seed. Sparingly naturalized from Europe. Scarce in Michigan.

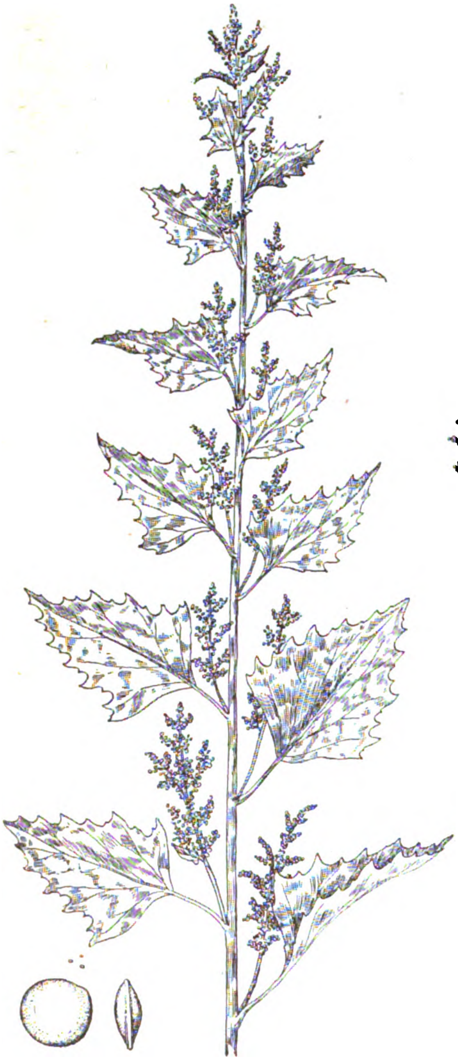


Fig. 54.

Upright Goosefoot. *Chenopodium urbicum* L. A dull green annual, scarcely mealy, 30-90 cm. high; leaves triangular, or narrowed at the base coarsely toothed, the larger, 6-10, cm. long; spikes erect, crowded in a long panicle. Naturalized from Europe. Not abundant. Waste grounds. Lansing, Ionia, Flint, Grand Rapids, Ann Arbor.

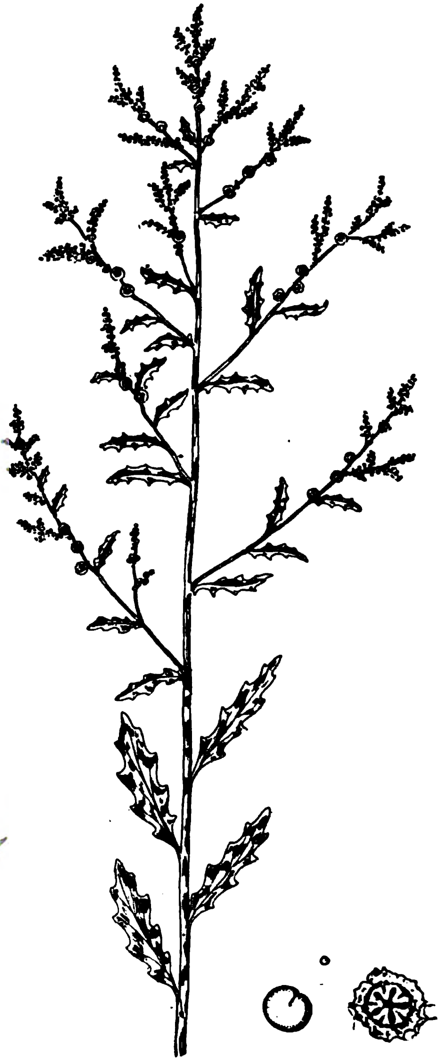


Fig. 55 (52).

Winged Pigweed. *Cycloloma atriplicifolium* (Spreng.) Coulter. A densely bushy-branched, pale green annual becoming purple, a tumbleweed, 10-40 cm. high; leaves petioled, blades lanceolate, sinuate-toothed, 2-6 cm. long; panicles loosely flowered. Occasional, coming from the west. Lansing, Port Huron, Manistee, Keweenaw County. May be expected wherever Russian thistles grow, as both follow railways, ballast of ships, and both are tumbleweeds.

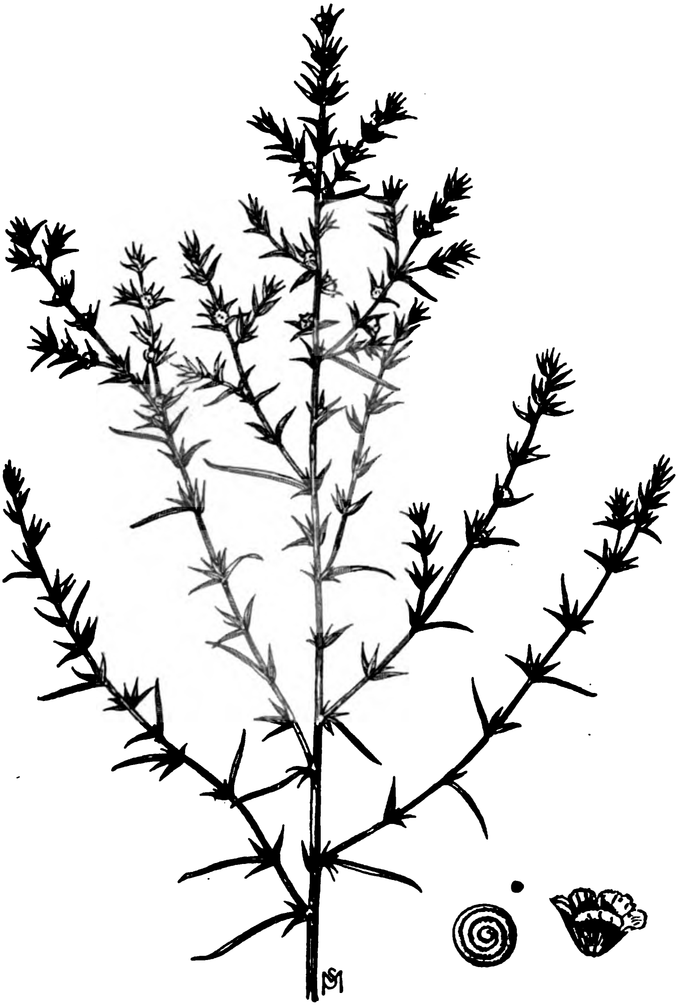


Fig. 56 (53).

Russian Thistle. *Salsola Kali tenuifolia* G. F. W. Mey. (*Salsola Tragus* L.) A dense, bushy annual, 30-90 cm. high, a tumbleweed; young plants soft, succulent, bearing cylindrical leaves, 3-7 cm. long, relished by sheep; leaves of older plants awl-shaped, prickly-pointed; the whole plant streaked and splashed with bright red when mature. Especially troublesome in spring wheat and other annual crops. Introduced into the Northwestern States from Russia, and from there spread eastward carried by railway trains and mixed with seeds of alfalfa and red clover.

THE PRICKLY PIGWEEDS. AMARANTH FAMILY. AMARANTHACEAE.

Weedy herbs; flowers greenish-white, minute, surrounded by prickly bracts or scales, often colored. A small family including about 425 species, mostly growing in tropical regions.

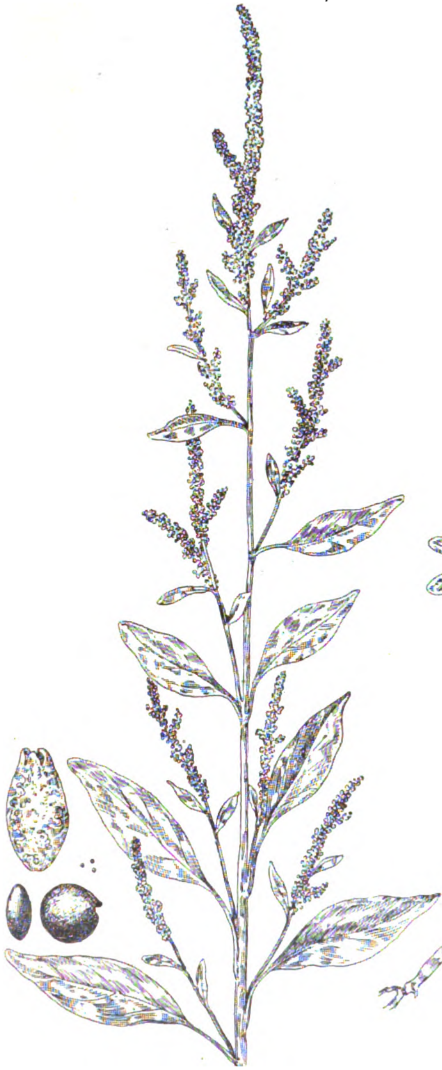


Fig. 57 (54).

Western Water Hemp. *Acnida tuberculata* Moq. An erect, slender, dioecious annual, 30-90 cm. high; leaves lanceolate or rhombic-ovate, usually acute, 4-12 cm. long; spikes mostly loose or interrupted; flowers surrounded by soft prickly bracts. Frequent along the Grand River Valley. Native to this country.

Some plants of this species are prostrate but seeds of the prostrate do not all of them produce prostrate forms.

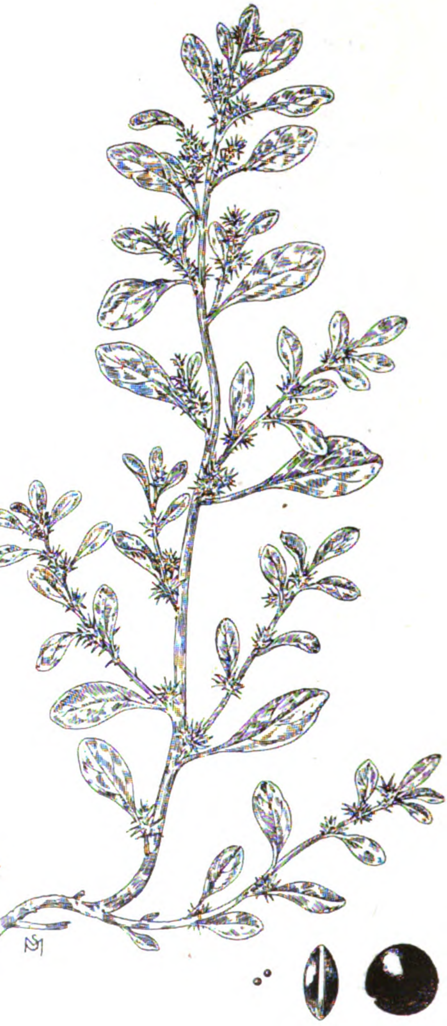


Fig. 58 (55).

Prostrate Amaranth. *Amaranthus blitoides* S. Wats. A smooth, pale green, much-branched, prostrate annual, 12-60 cm. or more long; leaves obovate or spatulate, 0.5-2 cm. long. In waste places, especially along railroads. Naturalized from the west.

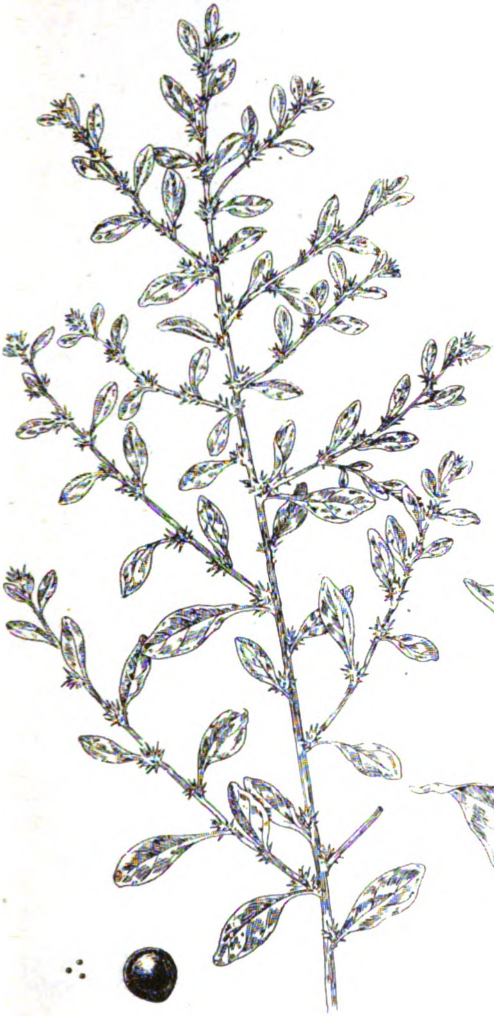


Fig. 59 (56).

Tumble Weed. *Amaranthus graecizans* L. (*A. albus* L.) A smooth, pale green, bushy, branched annual, 30-60 cm. high; leaves oblong or spatulate, 0.5-1.5 cm. long; bracts awlshaped. Naturalized from tropical America, and widely distributed in North America. Sandy and gravelly, well drained soil, becoming when mature a model tumble weed.

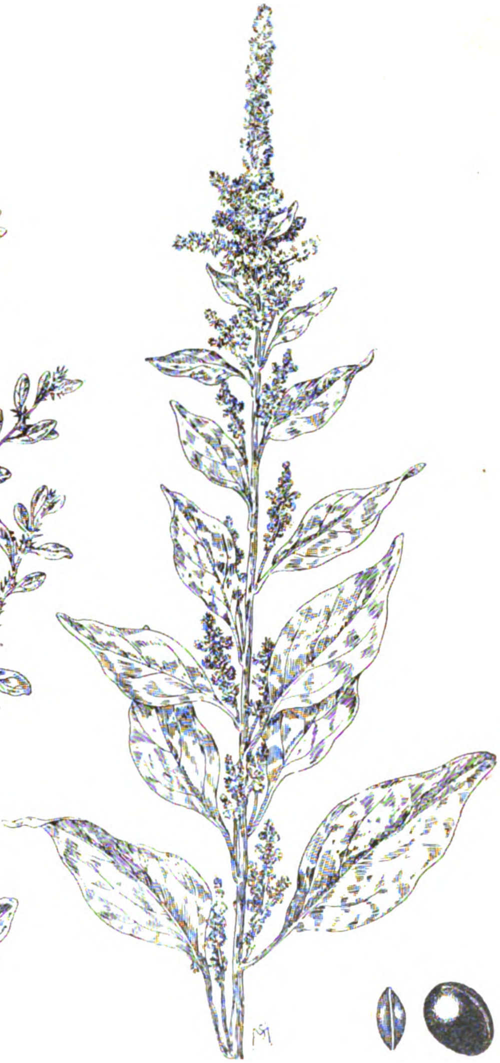


Fig. 60 (57).

Green Amaranthus. Rough Pigweed. *Amaranthus hybridus* L. (*A. chlorostachys* Willd.) Usually slender, erect, dark green, nearly smooth, annual, 60-240 cm. high; leaves bright green both sides; spikes slender-cylindrical, bracts rather long. Cultivated grounds. Common east, but scarce in Michigan. Introduced from tropical America.

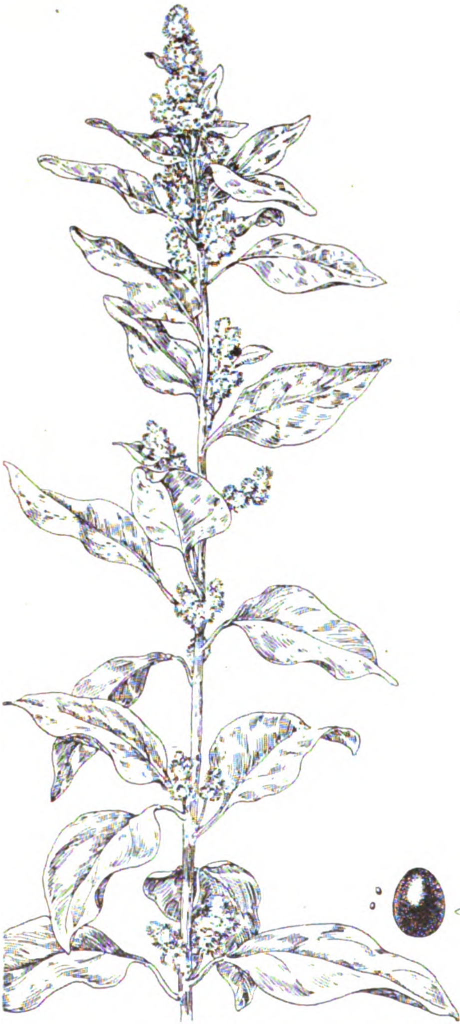


Fig. 61 (58).

Rough Pigweed. Red-root Pigweed. *Amaranthus retroflexus* L. Rough and more or less pubescent, rather light green, leaves long petioled, ovate or rhombic-ovate, wavy margined; spikes thick, crowded, stiff. Much like the foregoing species; the prevailing one in Michigan. Very common in annual crops of corn, beets, beans, potatoes. Introduced from tropical America.

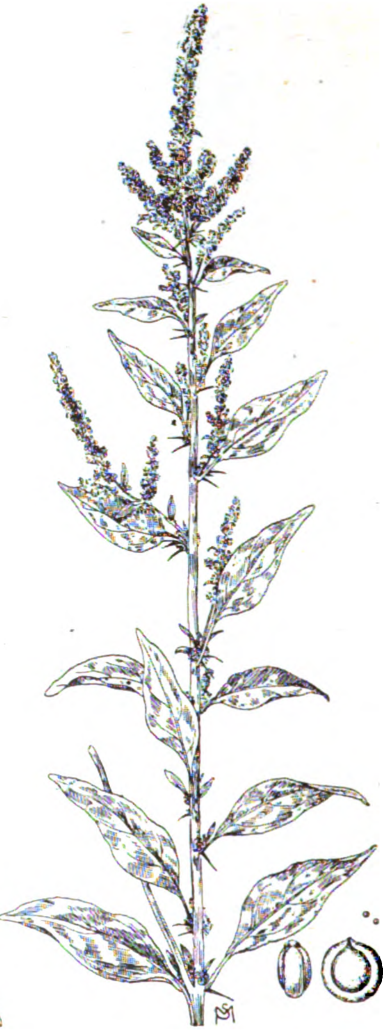


Fig. 62.

Spiny Amaranth. *Amaranthus spinosus* L. A smooth, bushy-branched annual, 30-100 cm. high, considerably resembling *A. retroflexus*; leaves rhombic-ovate, dull green, differing from others described in having a pair of stiff spines at the base of each leaf. Common south, but rare in Michigan. Introduced from tropical America.

POKEWEED FAMILY. PHYTOLACCACEAE.

A single weedy plant, is native to the northern states. The small family contains about 85 species mostly native in the Tropics.

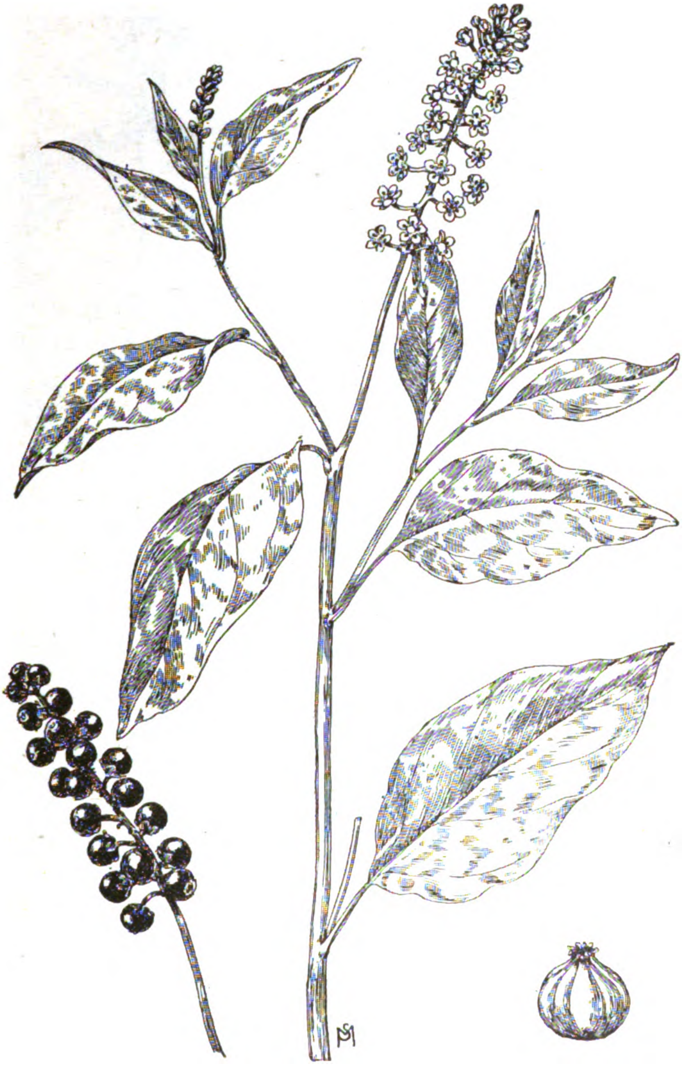


Fig. 63.

Pokeweed. Scokeroot. Pigeon Berry. *Phytolacca decandra* L. A tall, erect, smooth perennial, 1-1.5 m. high, tinged with red late in the season, roots large, fleshy, poisonous; leaves petiolate, oblong-lanceolate, acute at both ends; flowers in thin racemes, 4-16 cm. long; the berries dark purple, much liked by birds. Naturalized in Europe. Young shoots sometimes eaten like asparagus.

FOUR O'CLOCK FAMILY. NYCTAGINACEAE.

Mostly herbs, with simple, opposite, entire leaves and regular flowers; ovary enclosed in the base of a hardened calyx.

About 250 species of wide range, only two have been introduced into Michigan, besides the four o'clock sometimes cultivated.

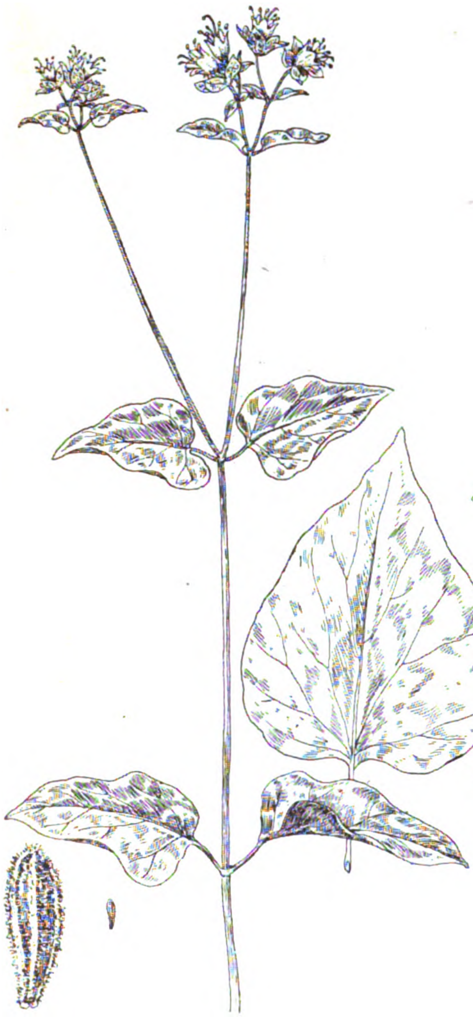


Fig. 64.

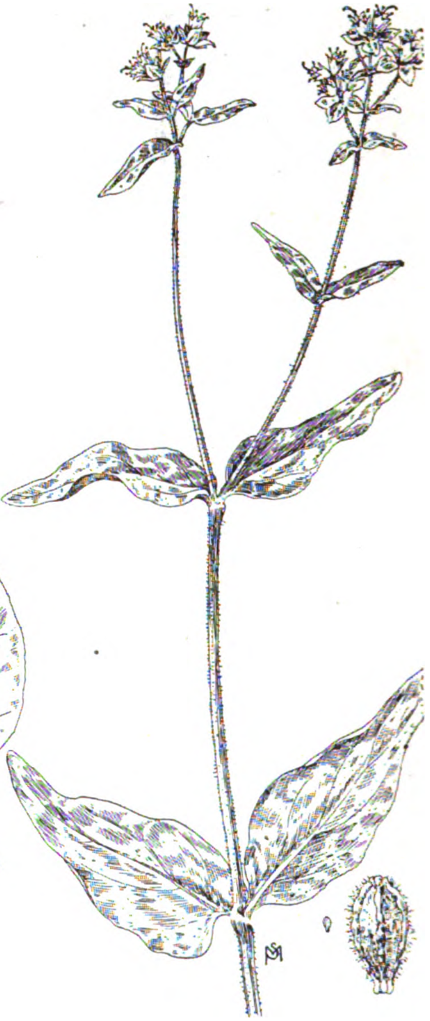


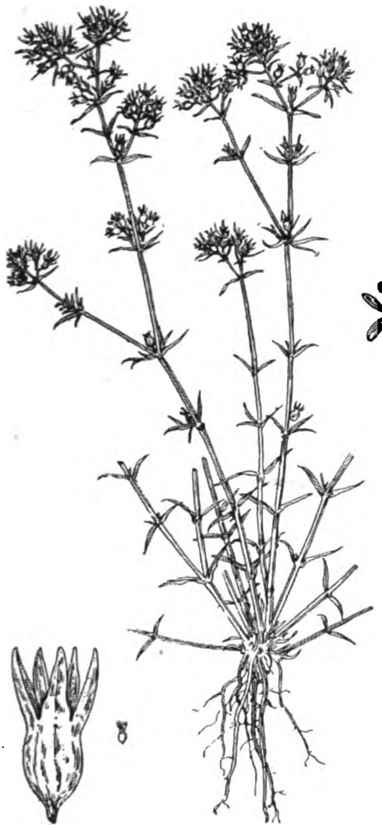
Fig. 65.

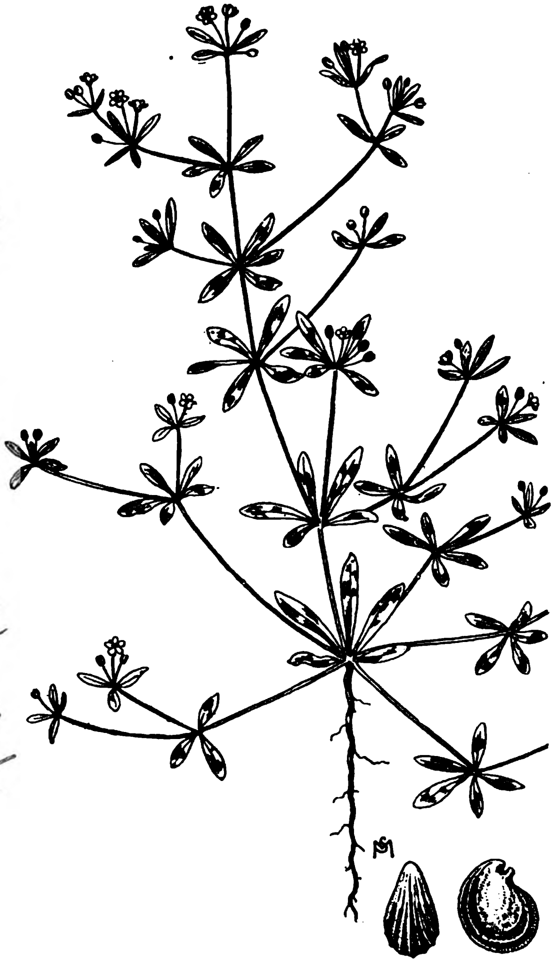
Heart-leaved Umbrella Wort. *Oxybaphus nyctagineus* (Michx.) Sweet. (*Allionia nyctaginea* Michx.) Perennial from a stout tap root, nearly smooth; stem angled, repeatedly forked, 30-150 cm. high; leaves broadly ovate, heart-shaped, 4-8 cm. long; involucre next the flowers more or less persistent to aid in distributing seeds; sepals red. Introduced from the south and west.

Found at Richmond, Oakland county and at the Agricultural College.

Mentioned here because in the Botanic Garden, it behaves much like narrow-leaved dock, and is likely to become troublesome.

Hairy Umbrella-wort. *Oxybaphus hirsutus* Pursh, has been found at Grand Rapids. It differs from the preceding in being glandular-hirsute, leaves sessile, lanceolate, narrowed at the base, considerably resembling the preceding.





KNOTWEED FAMILY. ILLECEBRACEAE.

The plants of this small family much resemble those of the Pink family, and by many authors are placed in that family.

Fig. 66 (59).

Knawel. *Scleranthus annuus* L. A homely, light colored, much branched, little weed, 4-12 cm. high; leaves awl-shaped; flowers obtuse, seed held by the hard persistent calyx; having the appearance of a dry-ground chickweed.

Naturalized at the Agricultural College and at Ann Arbor. Introduced from Europe.

CARPET-WEED FAMILY. AIZOACEAE.

Mostly herbs, prostrate and branching, differing from purslane and the chickweeds by having the ovary two-several-celled, stamens and petals sometimes numerous. About 500 species, mostly of warm regions, only one having reached Michigan.

Fig. 67 (60).

Carpet-weed. Indian Chickweed. *Mollugo verticillata* L. A smooth, prostrate, much-branched annual, forming mats; leaves in whorls, spatulate. Introduced from farther south. Sandy fields and roadsides in the central and southern regions of the state.

PINK FAMILY. CARYOPHYLLACEAE.

This rather large family of herbaceous plants includes such a variety that it is difficult to define to any except botanists. It contains many sorts of pinks and carnations, and is one of the families abounding in weeds.

There are about 1,500 species, most abundant in the northern hemisphere, especially in Europe.

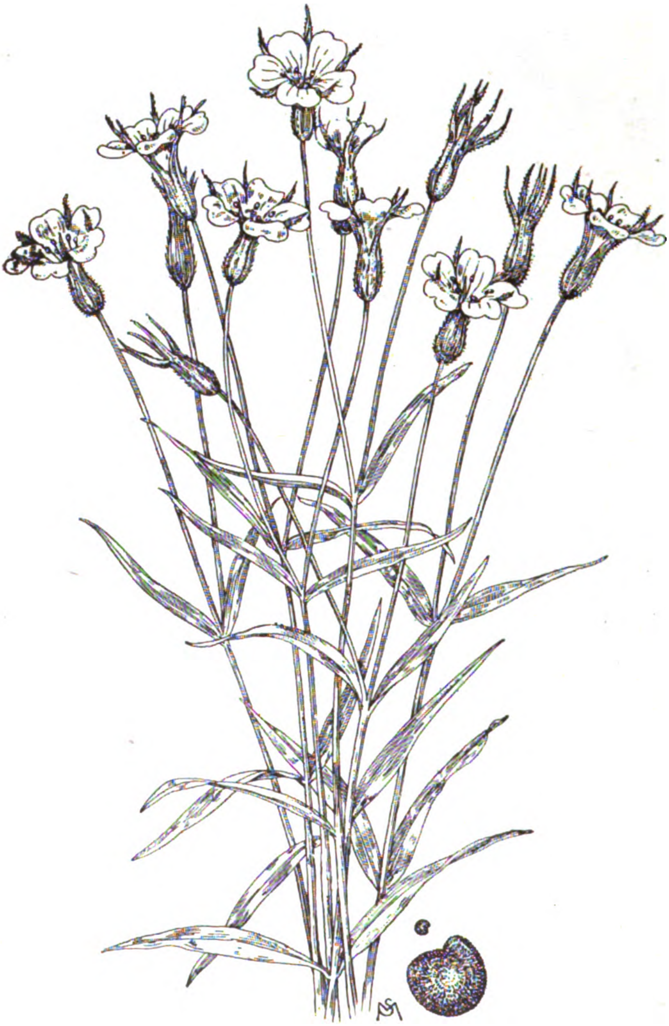


Fig. 68 (61).

Cockle. Corn Cockle. *Agrostemma Githago* L. A tall, silky, erect, fall annual; 30-90 cm. high; flowers large, red or pink, scarcely a weed except in fields of wheat; seed black, poisonous. Introduced from Europe.

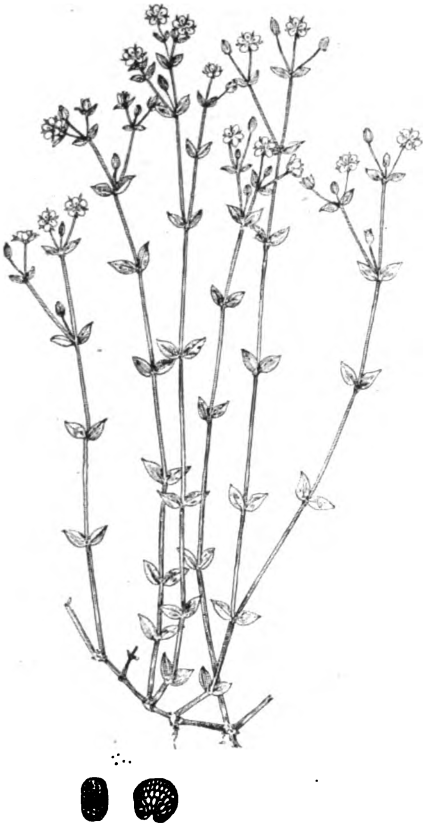


Fig. 69 (62).

Thyme-leaved Sandwort. *Arenaria serpyllifolia* L. A light-colored annual, slender, much branched and spreading, roughish, 5-15 cm. high; leaf stems short, blades ovate, acute, 4-8 mm. long; flowers small, white, numerous. Sandy soil. Introduced from Europe.

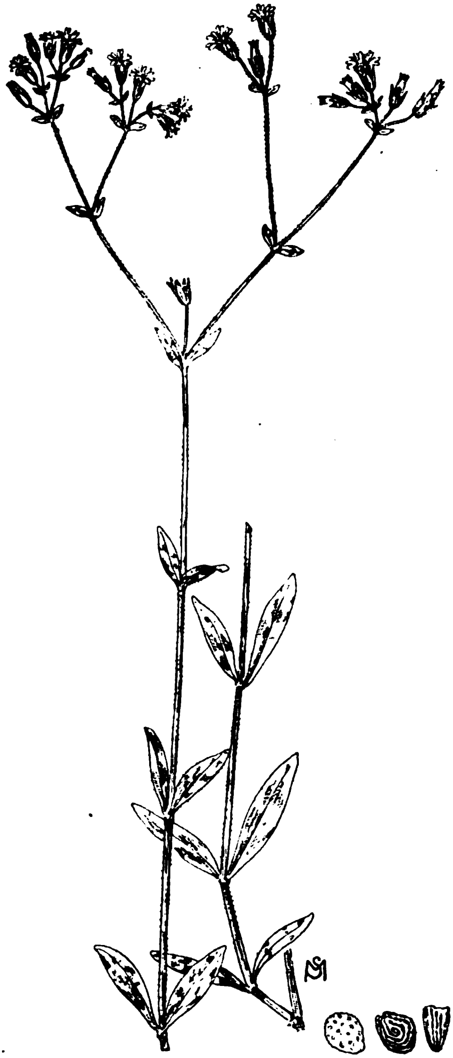


Fig. 70 (63).

Larger Mouse-ear Chickweed. *Cerastium vulgatum* L. Annual or biennial, clammy-hairy, tufted, spreading, 15-40 cm. high; leaves mostly oblong, 12-20 mm. long; flowers small, white in loose compound cymes. Fields and gardens common. Introduced from Europe.

Cerastium arvense L. and its variety *oblongifolium*, also *C. viscosum* and perhaps other species are occasionally met with, but, as yet, they are of little importance.

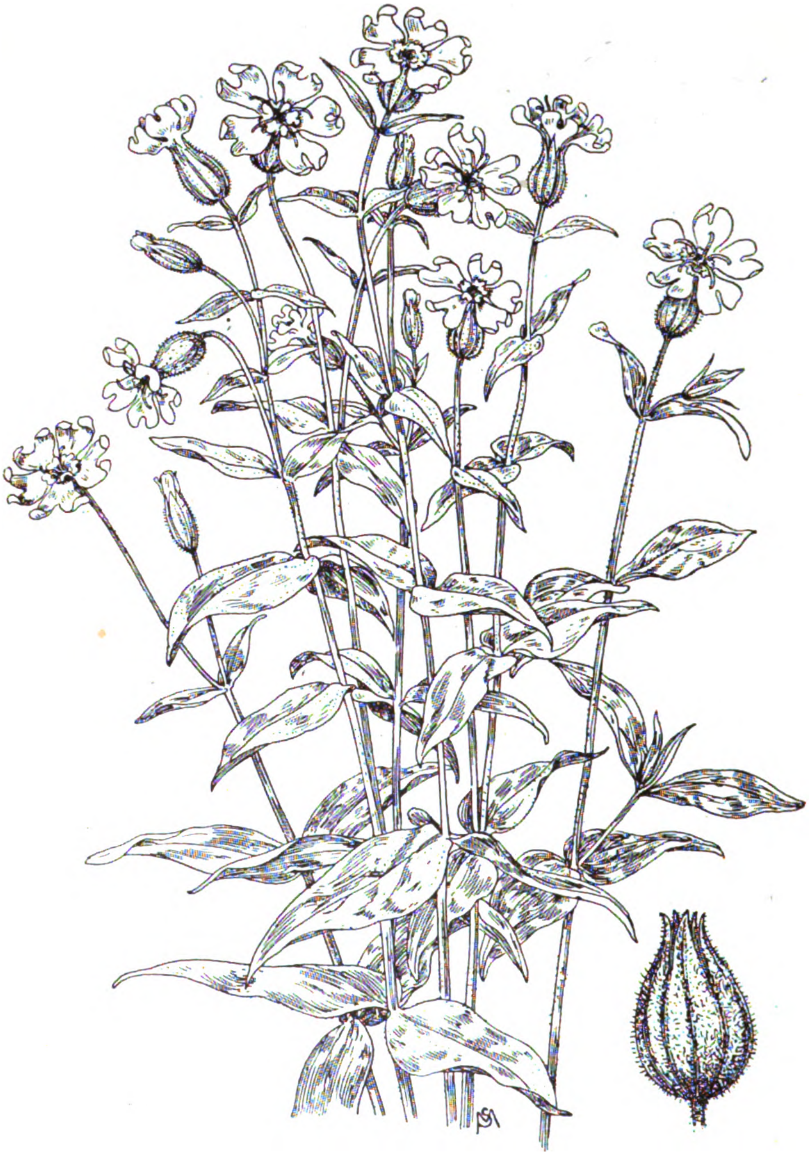


Fig. 71.

White Campion. *Lychnis alba* Mill. (*L. vespertina* Sibth.) Biennial, loosely branching, glandular, hairy, 30-60 cm. high; leaves ovate to ovate-oblong, acute 2-6 cm. long; flowers few in loose panicles, white or pinkish, opening toward night, often dioecious; calyx tubular, enlarging in fruit; petals obovate, two-cleft, each with a ligule at the base of the blade.

Becoming common in the lower peninsula. Naturalized from Europe.

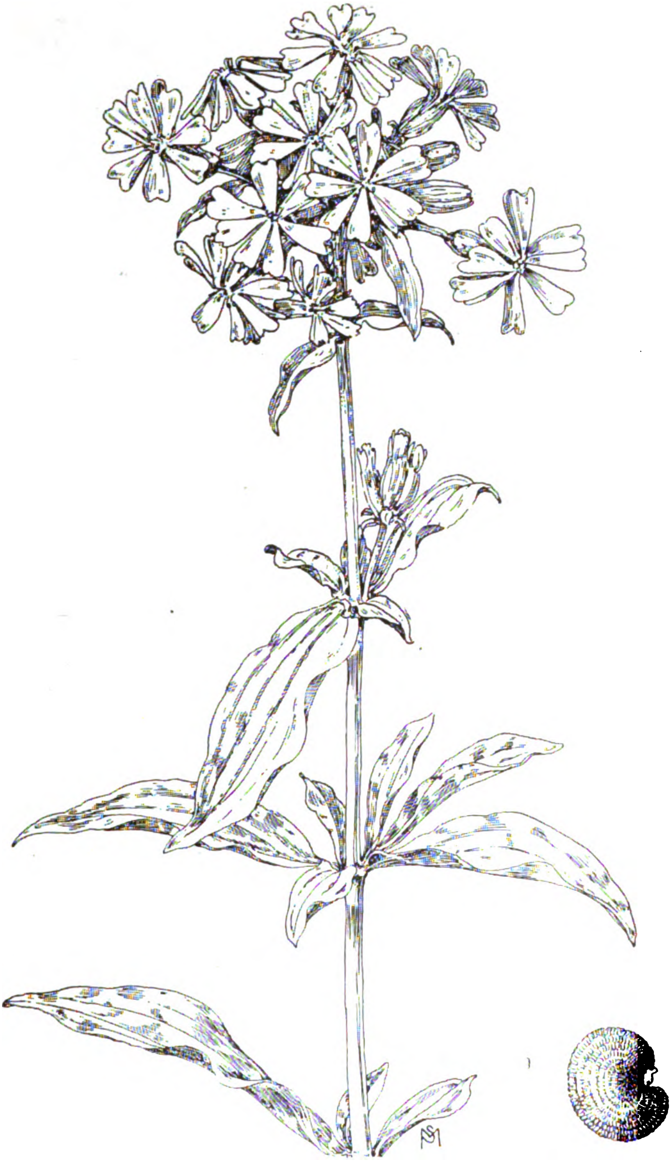


Fig. 72 (64).

Soapwort. Bouncing Bet. *Saponaria officinalis* L. Perennial, smooth, stout, sparingly branched, leafy, 30-50 cm. high; leaves opposite, ovate or oval, 3-5-ribbed, acute, 4-6 cm. long; flowers, pink or white in dense terminal cluster, sometimes double, calyx tubular, corolla about 2 cm. broad, petals obcordate, with a scale at the base of the blade; the mucilaginous juice forming a lather with water. Spreading from root stocks, common along roadsides and in waste places, especially in sandy land. Introduced from Europe.

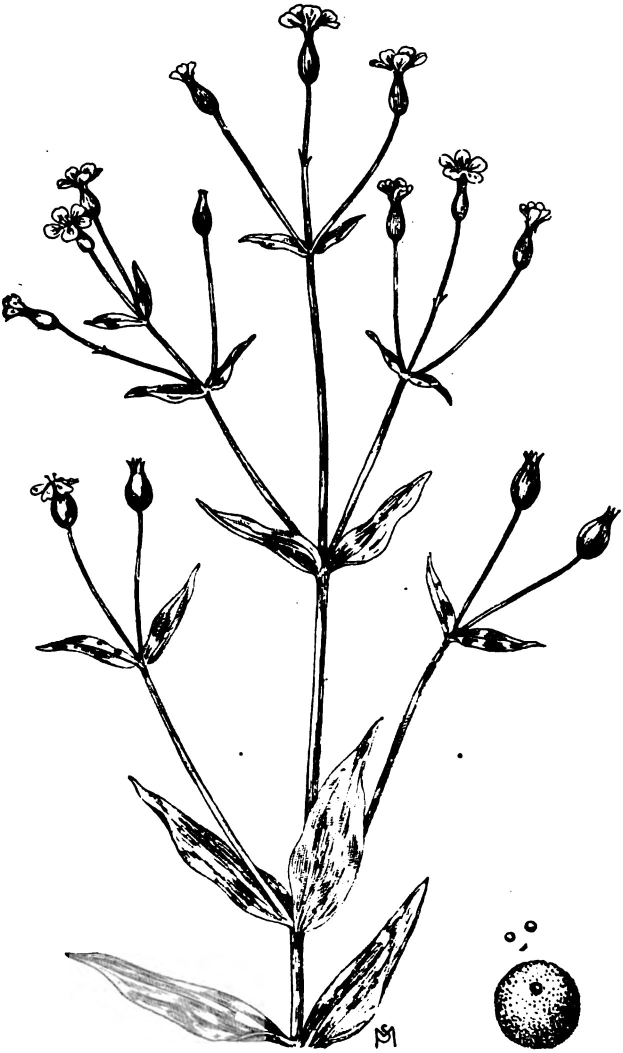


Fig. 73 (65).

Cow-herb. *Saponaria Vaccaria* L. (*Vaccaria Vaccaria* (L.) Britton.) Annual, smooth, erect, sparingly branched, 30-80 cm. high; leaves sessile, opposite, ovate-lanceolate, 2-6 cm. long; flowers pale red, 30-40 mm. broad; fruit enlarged, five-ribbed. Occasionally a weed in fields of grain. Introduced from Europe.

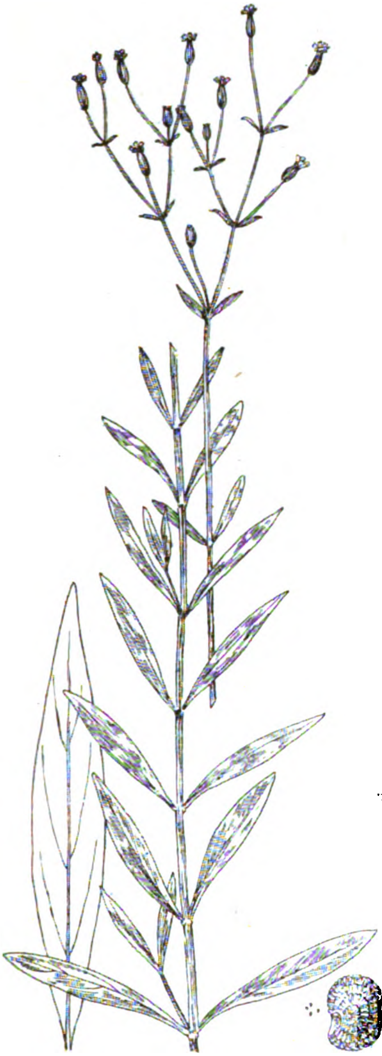


Fig. 74 (66).

Sleepy Catch-Fly. *Silene antirrhina* L. A slender, erect, slightly-branched annual, 20-90 cm. high, when in flower glutinous along two of the upper internodes. Leaves linear or lanceolate, narrowed into a petiole; inflorescence, a loose, cymose panicle; flowers small, pink, petals obcordate with minute teeth at the base of the blade.

Native of this country. Poor sandy soil perhaps introduced with Timothy seed.

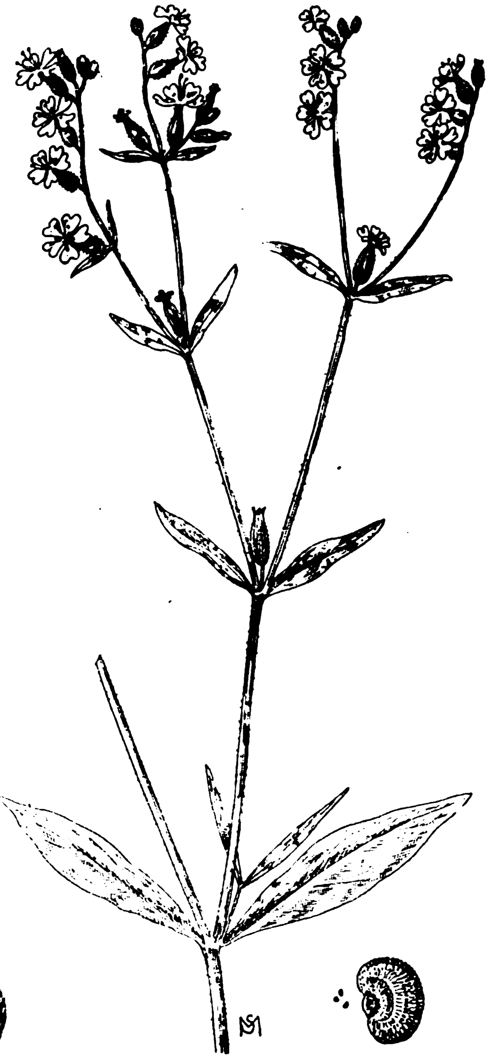


Fig. 75 (67).

Forked Catch-fly. *Silene dichotoma* Ehrh. Annual, erect, pubescent, 30-60 cm. high; leaves narrow; flowers white or pink, sessile or nearly so, in forked, one-sided spikes; calyx-ribs 5, hirsute.

Introduced with clover seed into several regions of the state and likely to be troublesome. It comes originally from Europe.

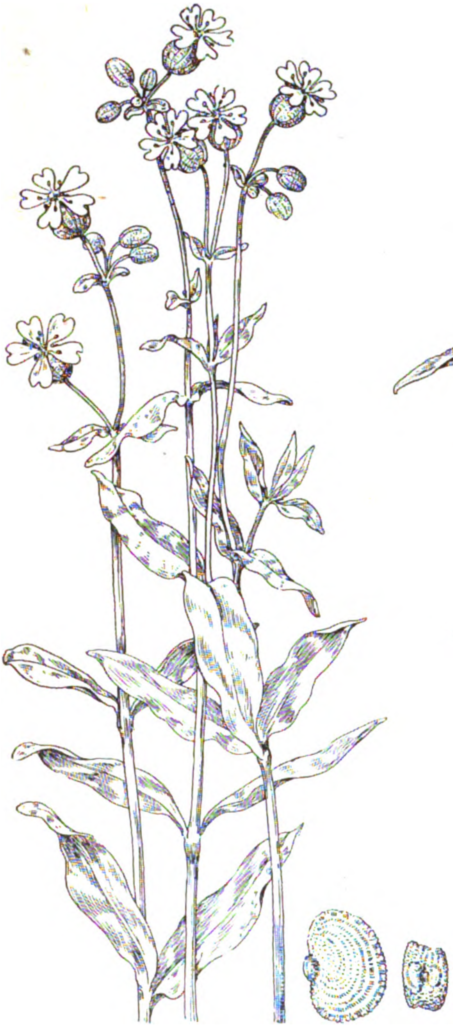


Fig. 76 (68).

Bladder Campion *Silene latifolia* (Mill.) Britten and Rendle. (*S. vulgaris* (Moench) Garcke, *S. Cucubalus* Wibel. *S. inflata* J. E. Smith.) A smooth, glaucous, spreading perennial, 10-20 cm. high; leaves opposite, ovate-lanceolate, variable in size; calyx globular, much inflated, petals two-cleft, white, 12-20 mm. broad.

Naturalized from Europe and becoming common in the state.

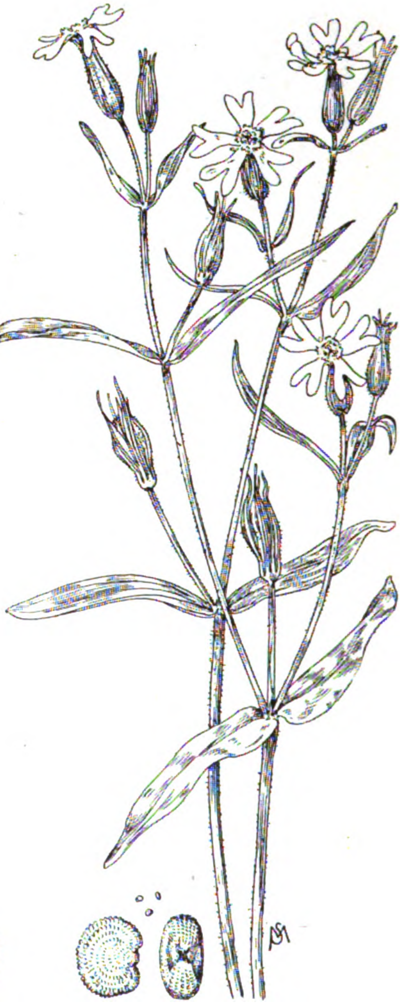


Fig. 77 (69).

Night-flowering Catch-fly. *Silene noctiflora* L. An erect, glandular, pubescent annual or biennial, 30-90 cm. high; lower leaves large and spatulate, the upper lanceolate, flowers in loose cymose panicles, fragrant, opening at night; calyx tubular, ten-nerved, enlarging in fruit; flowers few, petals two-parted, white or pinkish.

Common, seeds difficult to separate from clover seed. Introduced from Europe.

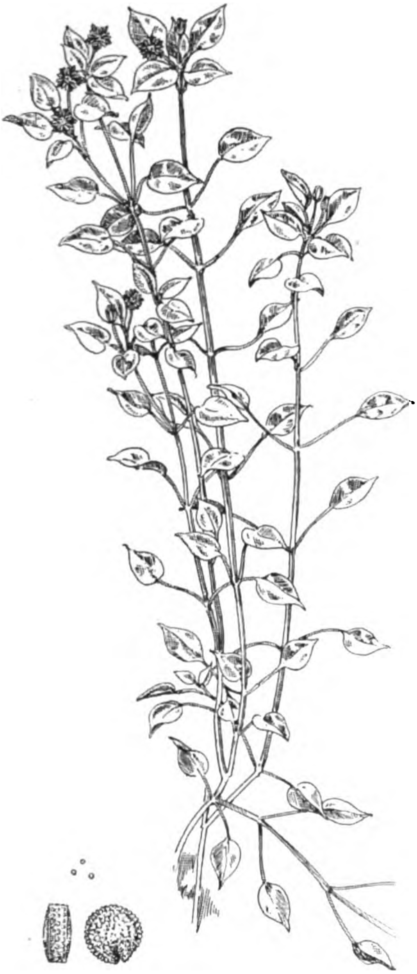


Fig. 78 (71).

Common Chickweed. *Stellaria media* (L.) Cyrill. (*Alsine media* L.) A weak, much-branched annual, 8-16 cm. high, smooth except hairs in lines on stem and petioles; leaves ovate or oval, the upper sessile; flowers in leafy cymes or solitary; petals white, two-parted. Introduced from Europe. Very common, especially abundant in spring and autumn when the weather is cool.

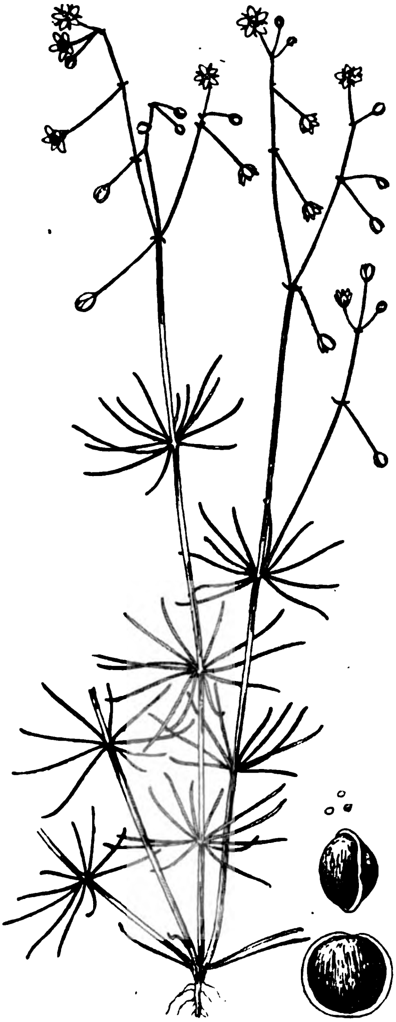


Fig. 79 (70).

Spurry. *Spergula arvensis* L. A bright green annual, 20-40 cm. high; leaves stipulate in whorls, thread-shaped, 2-5 cm. long; flowers white in terminal cymes.

Grain fields and waste places, especially in sandy land where some attempts were made to cultivate it in the northern portion of the lower peninsula. Naturalized from Europe.

PURSLANE FAMILY. PORTULACACEAE.

This small family of about 150 species consists of insipid herbs, mostly succulent and natives of America, of which one is a prominent well-known weed in Michigan.

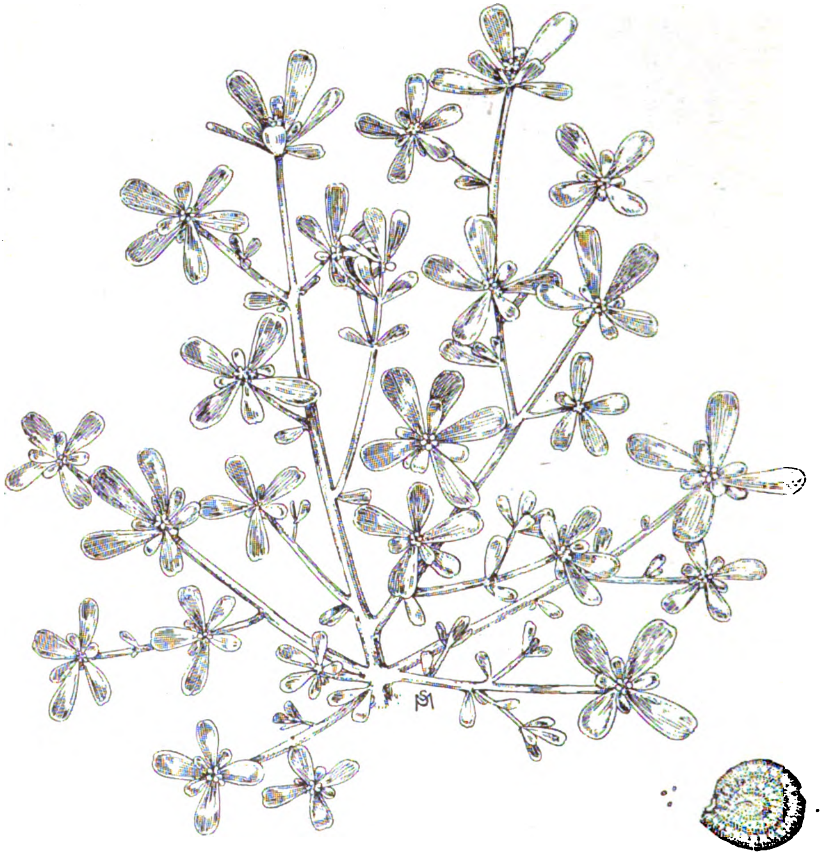


Fig. 80 (72).

Purselane. Pussley. *Portulaca oleracea* L. Smooth, prostrate, spreading, succulent, extending in each direction, 10-30 cm.; leaves thick, alternate, clustered at the ends of the branches, obovate, 6-20 mm. long; flowers yellow, opening in sunshine for a short time in the morning. Native in the southwest. Introduced into the warmer portions of Europe.

CROWFOOT FAMILY. RANUNCULACEAE.

Mostly herbs of greatly diversified forms pervaded by acrid juice, a few woody vines; parts of the flower free and distinct from each other; some poisonous and used for medicine; in the north temperate zone a considerable number blossom in early spring, such as hepatica, anemone, butter cup, columbine, marsh marigold, globe flower, hellebore, rue anemone. About 1,050 species widely distributed, but few in tropical regions.

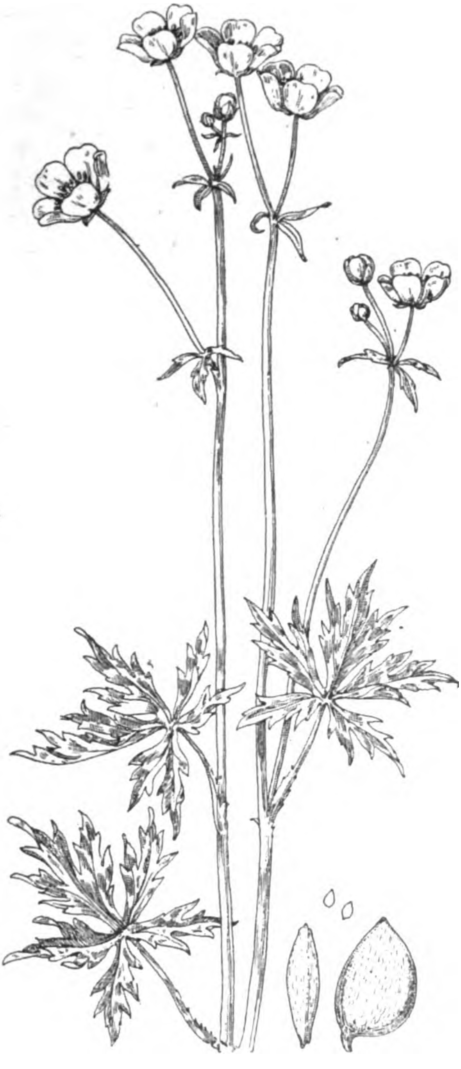


Fig. 81 (71).

Tall Buttercup or Crowfoot. *Ranunculus acris* L. Erect, hairy, perennial, 60-90 cm. high; leaves three-divided, each division three-cleft; petals yellow, shining. Fields and moist meadows and waste places, becoming common. Introduced from Europe.

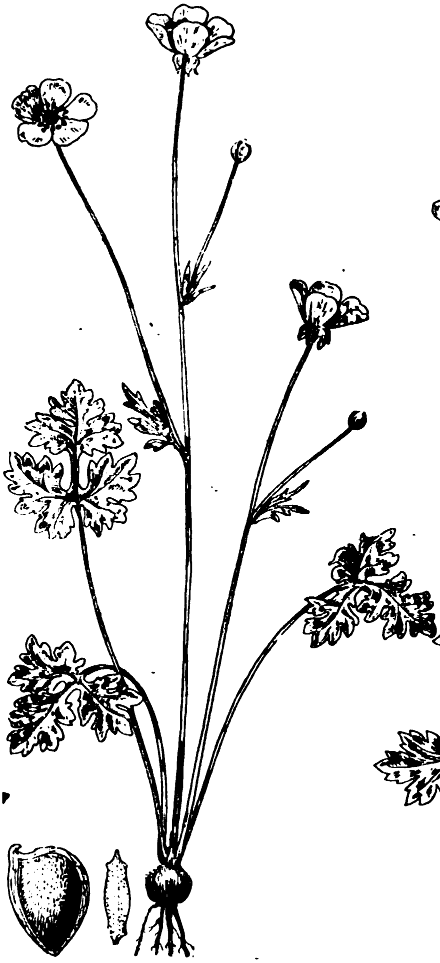


Fig. 82 (75.)

Bulbous Buttercup. *Ranunculus bulbosus* L. Erect, hairy, perennial, 30 cm. high, from a bulb-like base; lower leaves three-divided, each three-parted, three-cleft and toothed; flowers shining, bright yellow, about 2 cm. broad. Very common in meadows in New England, slowly spreading in Michigan.

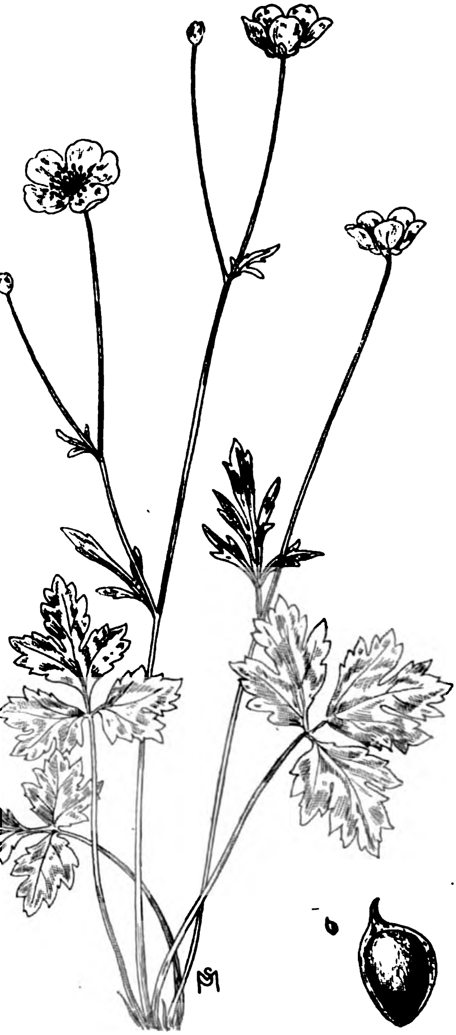


Fig. 83 (76).

Creeping Buttercup. *Ranunculus repens* L. Usually hairy, perennial, spreading by the rooting branches encroaching on grasses in meadows or lawns; leaves three-divided and variously cleft; flowers yellow, 2-2.6 cm. broad; seldom fruiting or fruiting sparingly. Introduced from Europe, perhaps indigenous in the west.

POPPY FAMILY. PAPAVERACEAE.

Herbs with milky or colored juice including poppies, bloodroot, celandine. A very small family widely dispersed in north temperate regions.

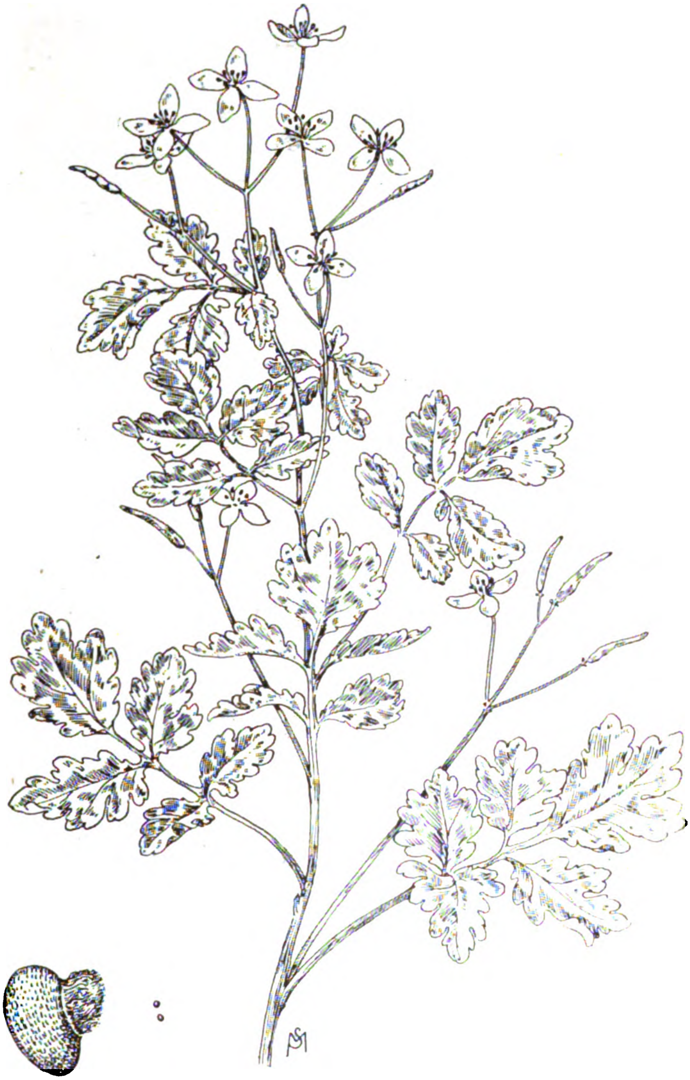


Fig. 84 (77).

Celandine. *Chelidonium majus* L. Perennial herbs, with saffron-colored acrid juice, 30-60 cm. high; leaves variously divided and cut-lobed; flowers small, yellow, often double; fruit linear-cylindric, opening by two valves, 2-5 cm. long. Naturalized from Europe.

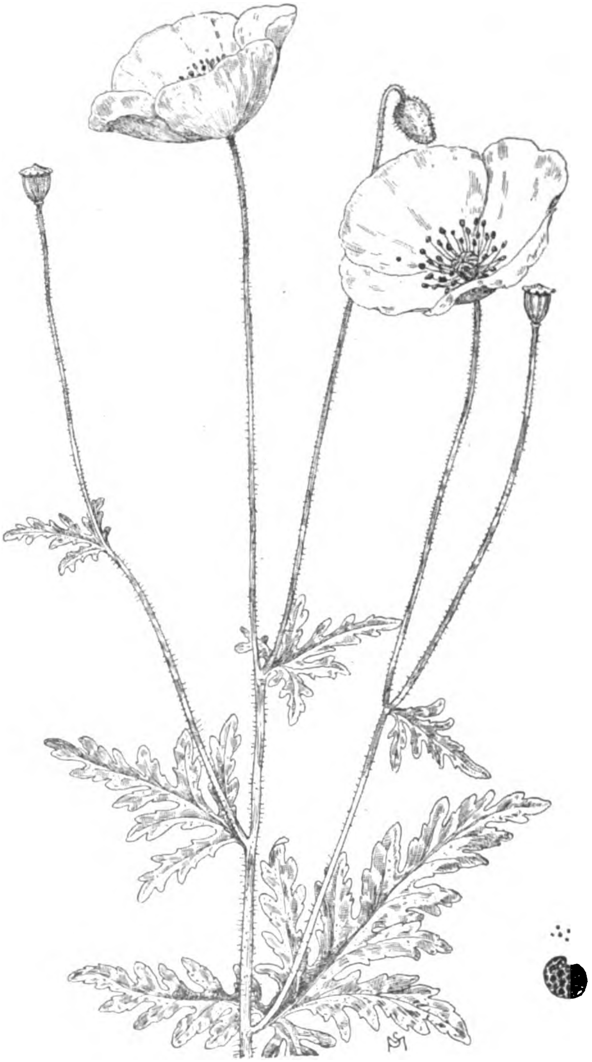


Fig. 85.

Poppy. *Papaver Rhoeas* L. Becomes a weed in some places, but is not difficult to subdue. The same may be said of *Papaver dubium* L.

MUSTARD FAMILY. CRUCIFERAE.

Herbs with a pungent acrid juice (horse radish), sepals 4, petals usually 4, the upper portion spreading in the form of a cross; stamens usually six, four longer than the other two, pod usually two-celled by a very thin vertical partition. Seeds of many species become mucilaginous when soaked in water. There are about 1,500 species, most abundant in temperate regions. The family is easily recognized, but the species are difficult to determine.

Useful plants of the family are the cabbage, cauliflower, turnip, ruta baga, radish, rape, sweet alyssum, stock and a few others. Weeds in this family are abundant and aggressive, new ones arriving one or more each year. It ranks as one of the prominent weed-families. None is poisonous.

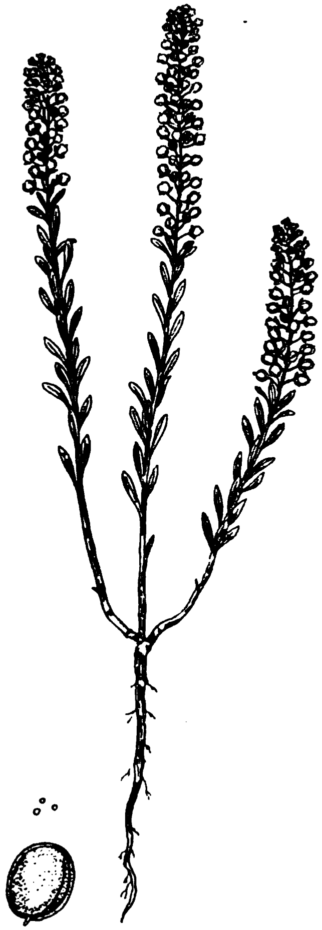


Fig. 86 (78).

Yellow or Small Alyssum. *Alyssum alyssoides* L. A small annual, 10-25 cm. high, appearing gray owing to immense numbers of star-shaped hairs on the surface; leaves mostly spatulate, entire; flowers yellow; fruit flat, nearly circular. Seldom prominent as a weed.

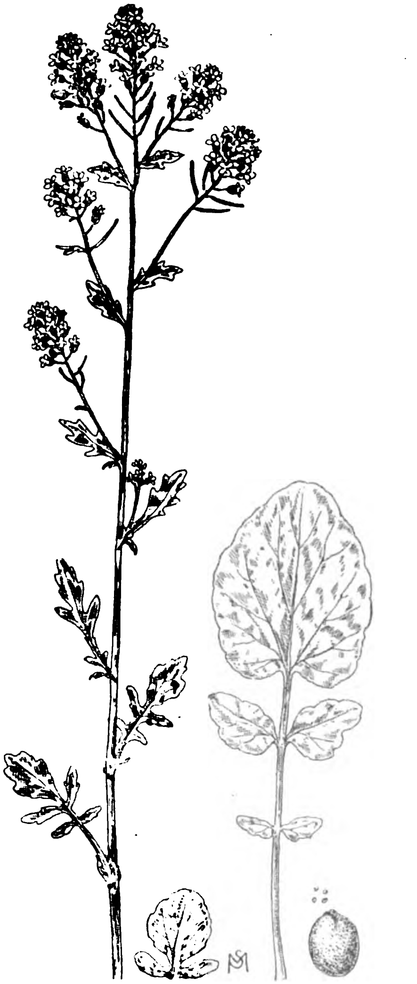


Fig. 87 (79).

Yellow Rocket. Winter Cress. *Barbarea vulgaris* R. Br. (*Barbarea Barbarea* (L.) Mac. M.) A smooth, erect, perennial, 30-60 cm. high; lower leaves with petioles, the blade lyrate-pinnatifid; flowers bright yellow, abundant; pod obscurely four-angled. Introduced from Europe. Rather frequent along ditches and low land. Often sent in for name, but so far not aggressive.

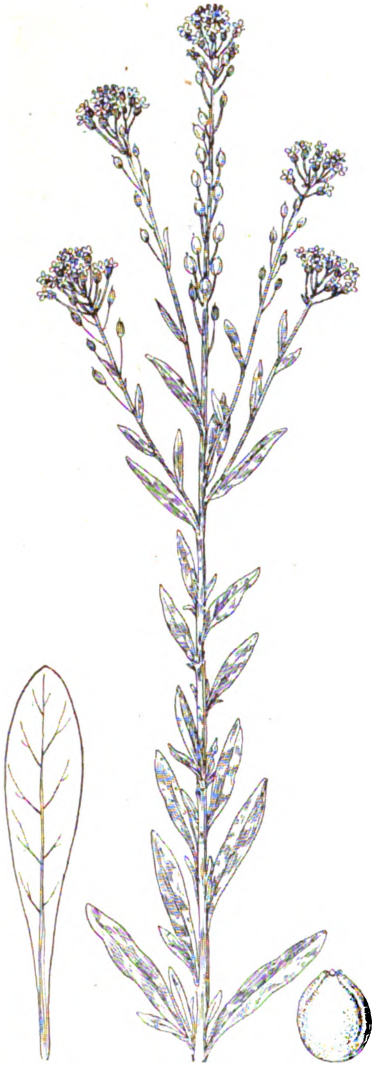


Fig. 88 (80).

Hoary Alyssum. *Berteroa incana* (L.) DC. A pale green, diffuse annual, 30-60 cm. high, thrifty, prolific and aggressive; leaves lanceolate or oblong; petals white, divided, pod oblong, plump, 2.5-3.5 mm. long.

Introduced from Europe, very recently found in Michigan, where it should be looked after without delay.

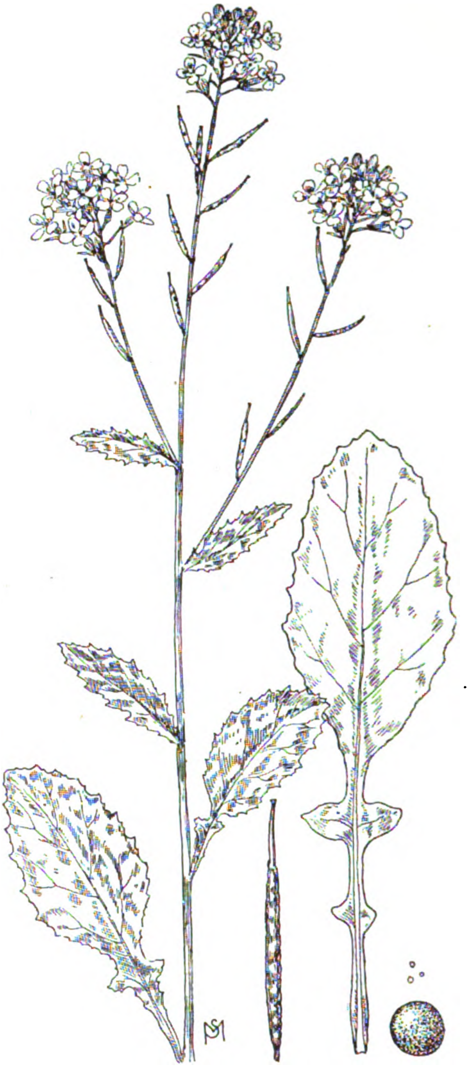


Fig. 89 (81).

Charlock. *Brassica arvensis* (L.) B. S. P. (*B. Sinapistrum* Boiss.) An erect, branching, hispid annual, 30-90 cm. high; lower leaves with petioles pinnatifid; flowers yellow, pod 4 cm. long, tipped with a flattened, elongated-conic beak, sometimes one-seeded. Difficult to identify; one mustard is about as bad as another; compare the apex of the pod and the seeds. Introduced from Europe.

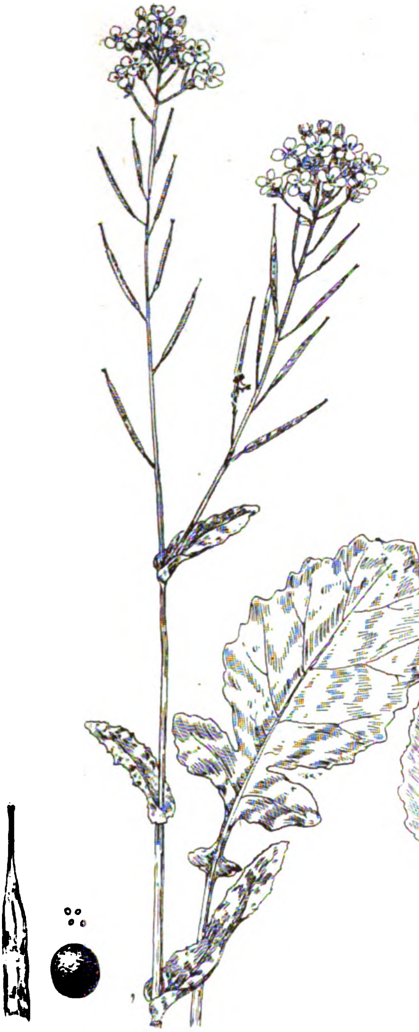


Fig. 90 (82).

Rutabaga. *Brassica campestris* L. Smooth or sparingly hairy annuals, 30-90 cm. high; lower leaves petioled, others clasping at the base; flowers bright yellow; pod tipped with a beak. Study and compare the beak and seeds with other species. From Europe, an occasional weed.

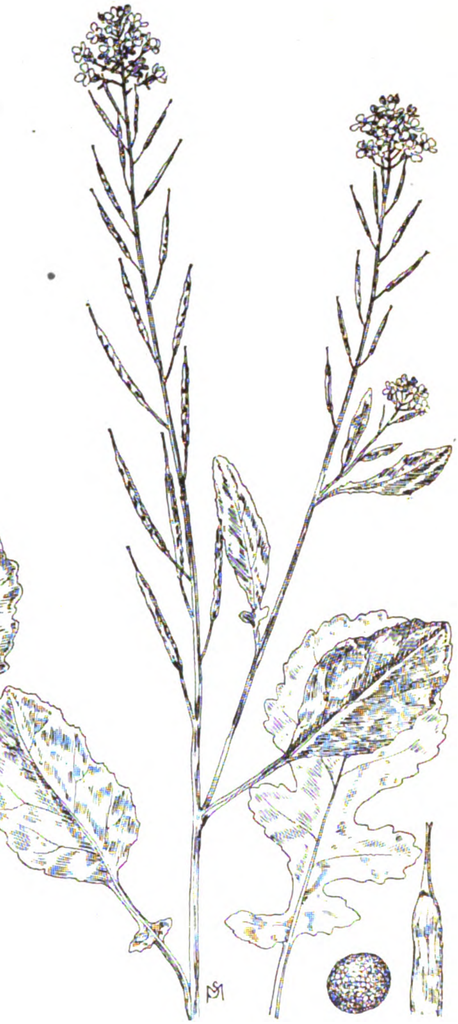


Fig. 91 (83).

Indian Mustard. *Brassica juncea* (L.) Cosson. An erect and branching annual more or less pubescent, 60-120 cm. high, lower leaves petioled, lyrate-pinnatifid; flowers yellow; pods 1.5-1.8 cm. long on short erect pedicels, oppressed, four-sided, beak 2-4 mm. long. Introduced from Europe. Compare beaks and seeds and the figures here represented. A bad weed, often confused with two, three or more others.

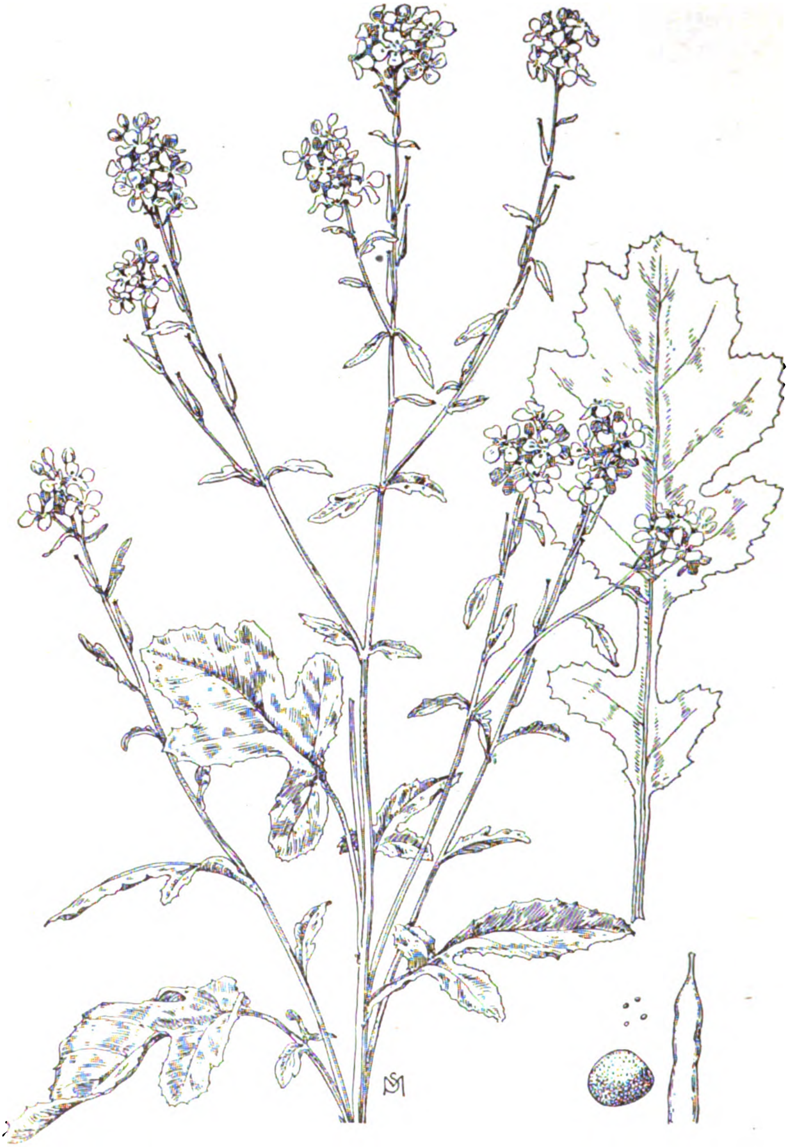


Fig. 92 (84).

Black Mustard. *Brassica nigra* (L.) Koch.
Notice the short pod with short abrupt beak. A common weed and aggressive.

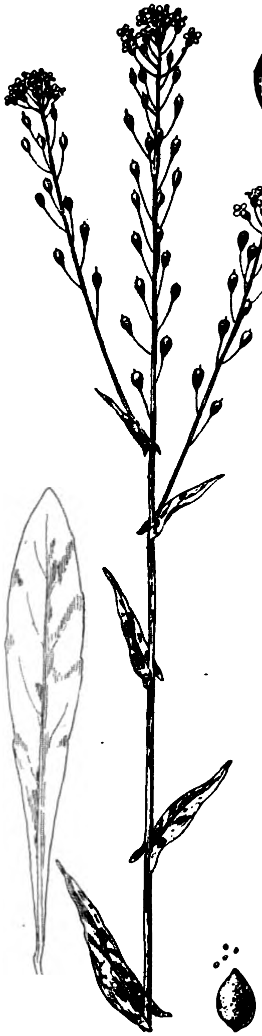


Fig. 93 (85).

Small-fruited False Flax. *Camelina microcarpa* Andrz. Annual, 30-60 cm. high; plant more slender than those of the other species: upper leaves auricled, flowers yellow; pods smaller. 4-5 mm. broad.

Introduced from Europe, becoming common in Michigan.

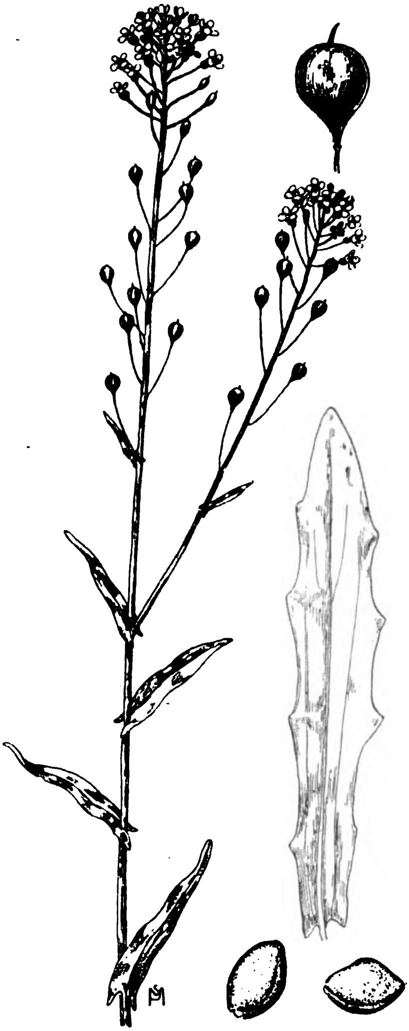


Fig. 94 (86).

False Flax. *Camelina sativa* (L.) Crantz. Annual, 30-60 cm. high, lowest leaves petioled, entire or toothed, 4-6 cm. long, upper leaves clasping, sagitate; flowers yellow, pod obovoid, margined, very slightly flattened, 6-8 mm. broad.

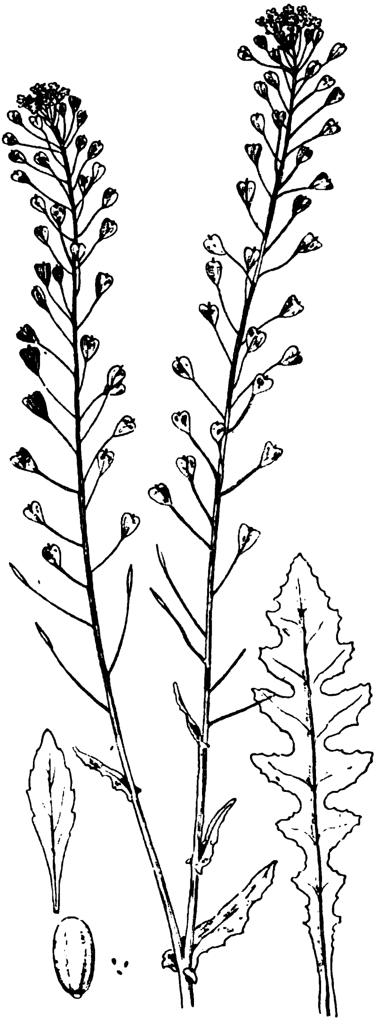


Fig. 95 (87).

Shepherd's Purse. *Capsella Bursa-pastoris* (L.) Medic. A fall annual, or annual, erect, branching, 15-40 cm. high; lower leaves variously pinnatifid, forming a rosette, stem leaves few, sagittate; flowers in racemes, white; fruit flat, triangular, about 5 mm. across. Naturalized from Europe and very widely distributed. Extremely variable.

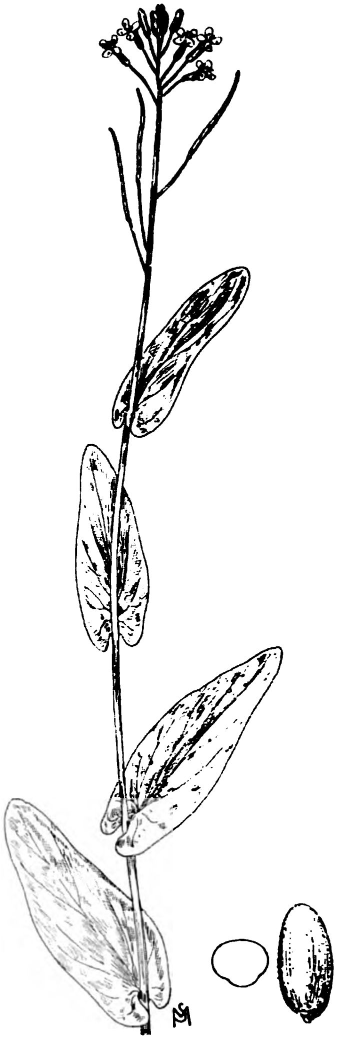


Fig. 96 (88).

Hare's-ear Mustard. *Conringia orientalis* (L.) Dumort. A smooth, slightly succulent annual, or fall annual, 30-120 cm. high; leaves fleshy, sessile, entire, flowers creamy white; pods erect, square, 7-10 cm. long.

Rapidly spreading in northwest British provinces; sparingly introduced into Michigan, originally from Europe.

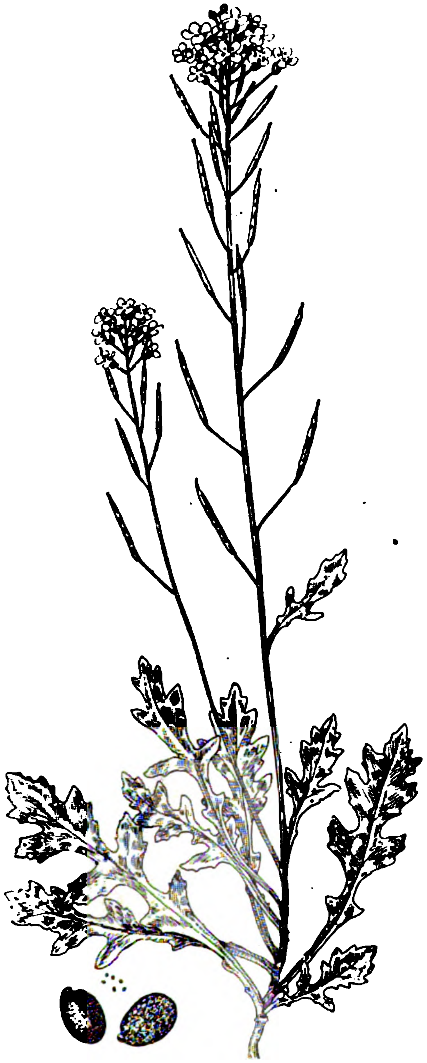


Fig. 97 (89).

Sand Rocket. *Diplotaxis muralis* (L.) DC. Annual, smooth or nearly so, branching from the base, 30-60 cm. high; leaves oblong, toothed or pinnatifid; flowers yellow, pods erect, linear, terete.

Introduced from Europe, and where it has been found in Michigan, thrives and spreads at an alarming pace.

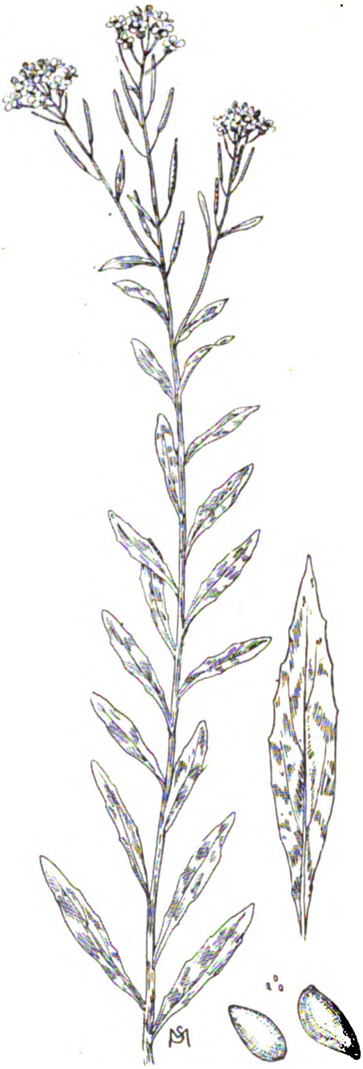


Fig. 98 (90).

Worm-seed or **Treacle, Mustard.** *Erysimum cheiranthoides* L. An erect, minutely-rough, annual, or winter annual, 20-60 cm. high; leaves lanceolate, entirely or slightly dentate, 2-8 cm. long, the lower with slender petioles, the upper sessile; flowers yellow, pedicels spreading at about 45 degrees, the pods not quite erect, but taking on uniform positions, four-angled, smooth, 1-2 cm. long.

Probably native to some portions of the north central states and Canada.

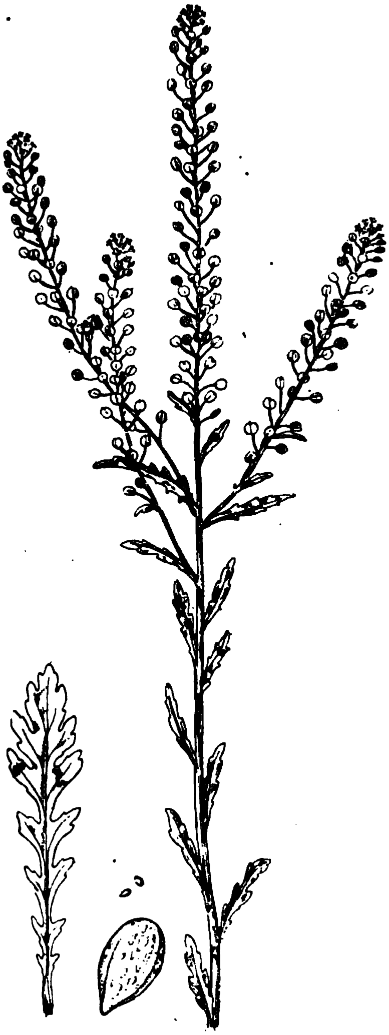


Fig. 99 (91).

Apetalous Pepper-grass. *Lepidium apetalum* Willd. Annual or winter annual, more or less hoary, racemes properly branched, lower leaves pinnatifid; petals wanting, or only two minute, and white; pod flat, more or less circular.

Waste places, seldom causing much trouble; when ripe becoming a tumble weed.

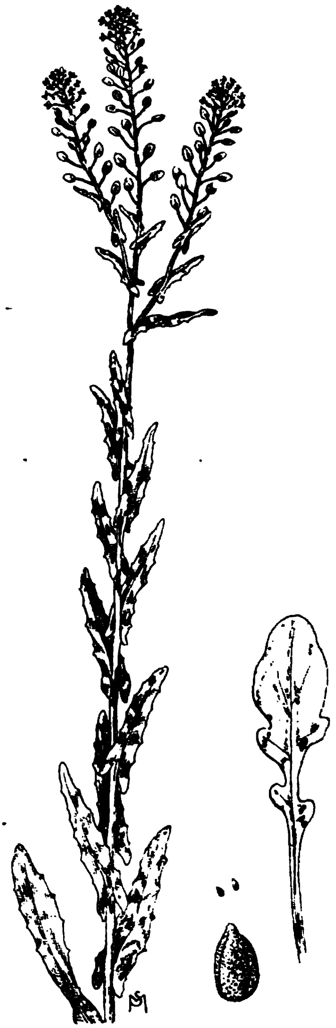


Fig. 100 (92).

Field Pepper-grass. Cow Cress. *Lepidium campestre* (L.) R. Br. A diffuse, hoary-pubescent biennial, 10-30 cm. high; stem leaves sessile with an arrow-shaped base; flowers white or yellowish; pods flattened, more or less circular.

Fields and waste places, naturalized from Europe.

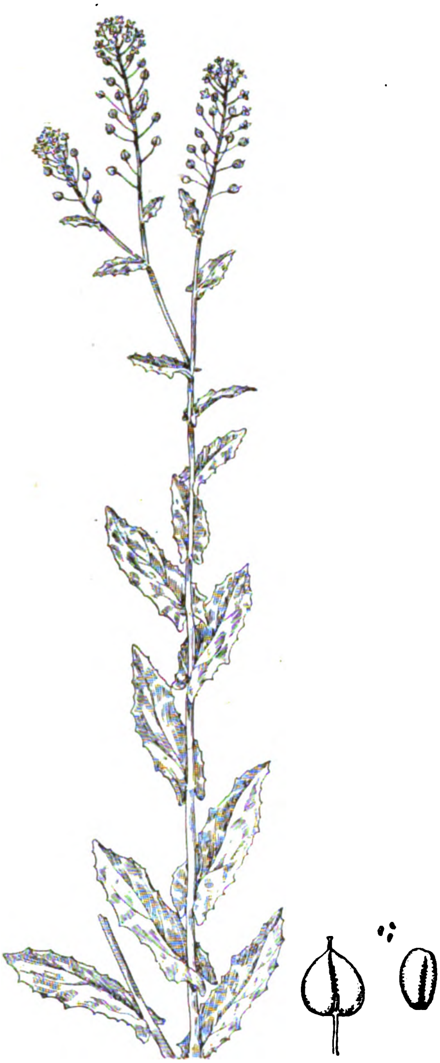


Fig. 101 (93).

Hoary Cress. *Lepidium Draba* L. An erect or ascending, hoary perennial, 20-35 cm. high; leaves oblong, entire or dentate, the lower petioled, flowers white; pods flat, broadly ovate.

Introduced from Europe, infrequent in Michigan.

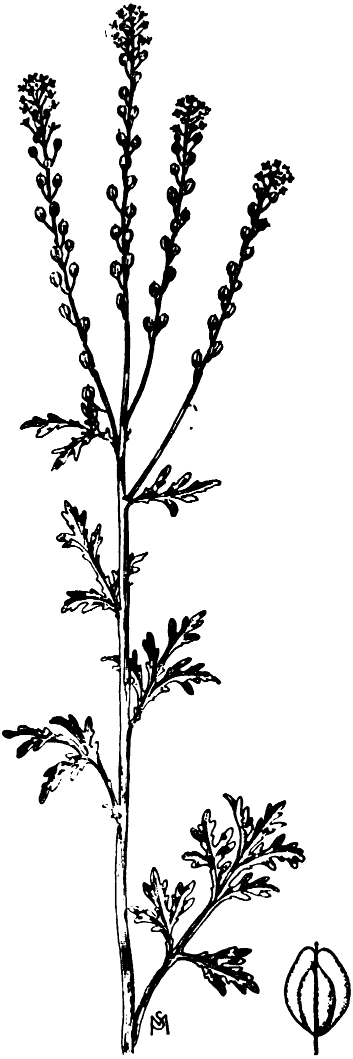


Fig. 102 (94).

Garden Cress. Golden Pepper-grass. *Lepidium sativum* L. A smooth, branching annual, about 30 cm. high; lower leaves two-pinnate; flowers white in long loose racemes, pod flattened, oval.

Introduced from Europe and escaped from cultivation.

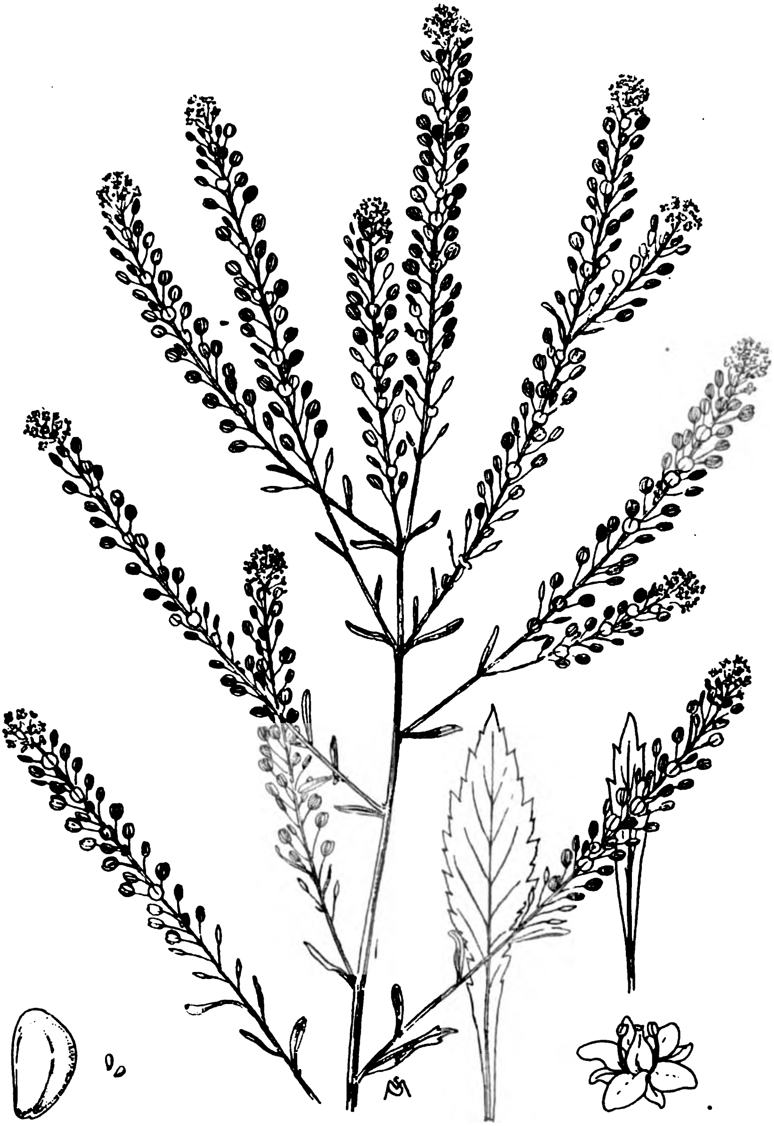


Fig. 103 (95).

Wild Pepper-grass. *Lepidium Virginicum* L. A diffuse annual or fall annual, 20-40 cm. high; lower leaves obovate in outline, usually with a large terminal lobe; stem leaves lanceolate, dentate; flowers-white; pod flat, nearly circular.

Common in waste places, sometimes a tumble weed; native to this country and introduced into Europe.

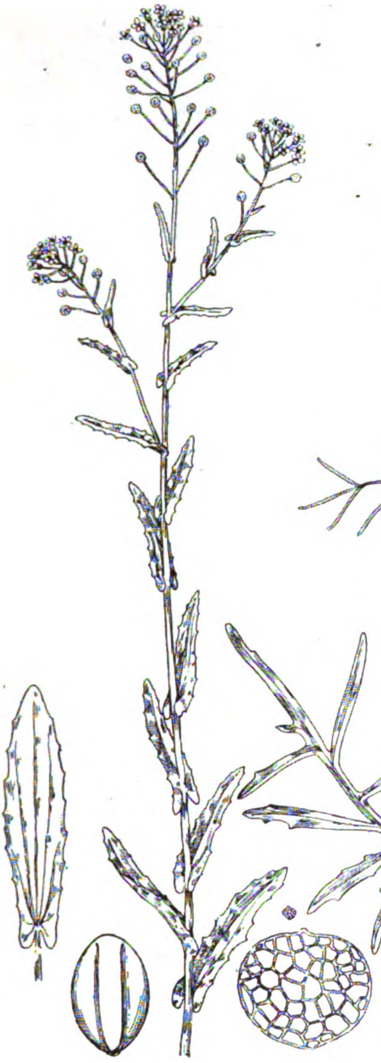


Fig. 104 (96).

Ball Mustard. *Neslia paniculata* (L.) Desv. A slender, branching annual, pubescent with star-shaped hairs, leaves oblong, sagittate; flowers in racemes; pods nearly spherical, 2-3 mm. in diameter.

Introduced from Europe into British Provinces of the northwest where it is very aggressive and may soon find its way to Michigan.

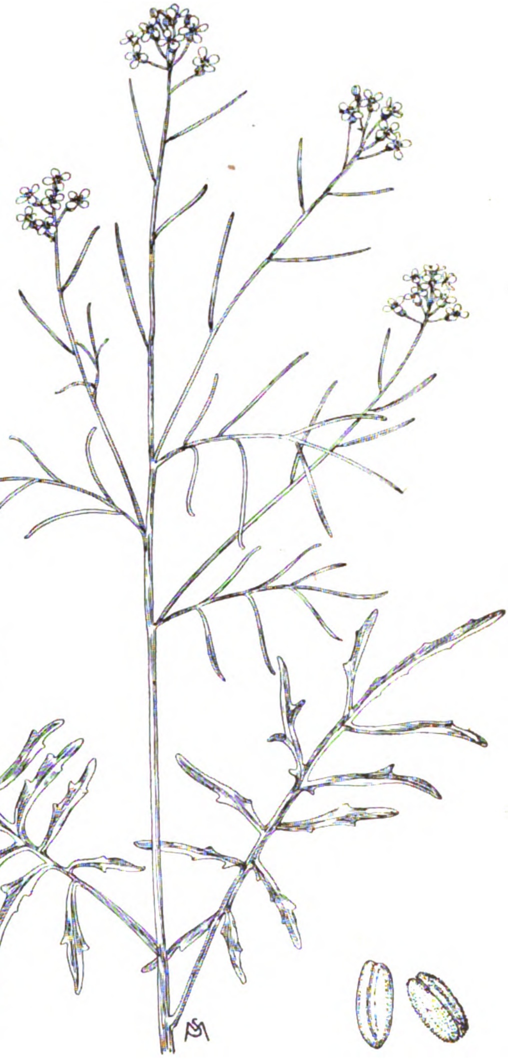


Fig. 105 (97).

Tumbling Mustard. Tall Mustard. *Sisymbrium altissimum* L. An erect, smooth, branching annual, 60-120 cm. high; leaves deeply pinnatifid; flowers pale yellow; pods narrow, stiff, diverging, 5-10 cm. long; seeds minute and enormously abundant; when mature the plant loosens from the soil becoming a first-class tumble weed; not yet abundant in Michigan but will soon become so.

Naturalized from Europe, with all the bad characteristics of a mustard.

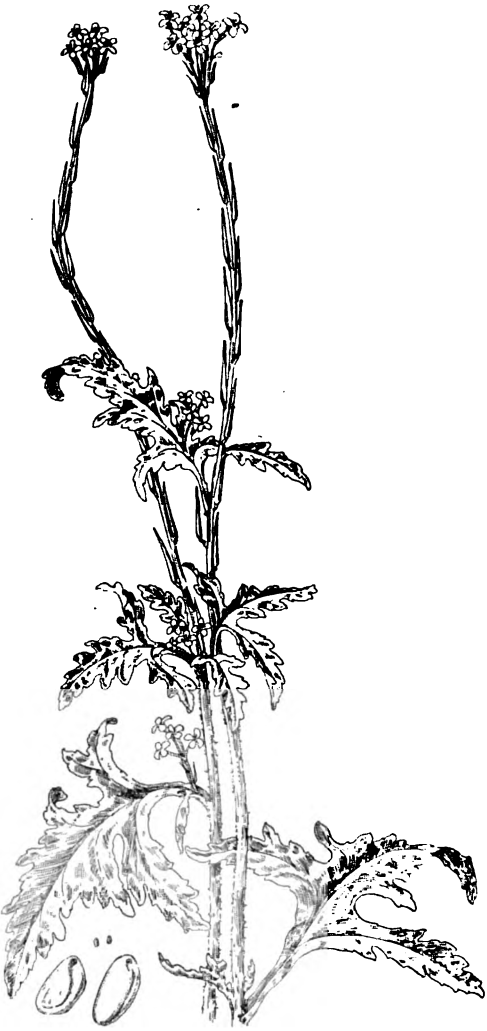


Fig. 106 (98).

Hedge Mustard. *Sisymbrium officinale* (L.) Scop. A rather stiff, slender nearly smooth biennial, 30-90 cm. high; leaves pinnatifid; flowers small, yellow; pods narrow, stiff, closely pressed to the stem. Not a vicious but a homely weed. Introduced from Europe.

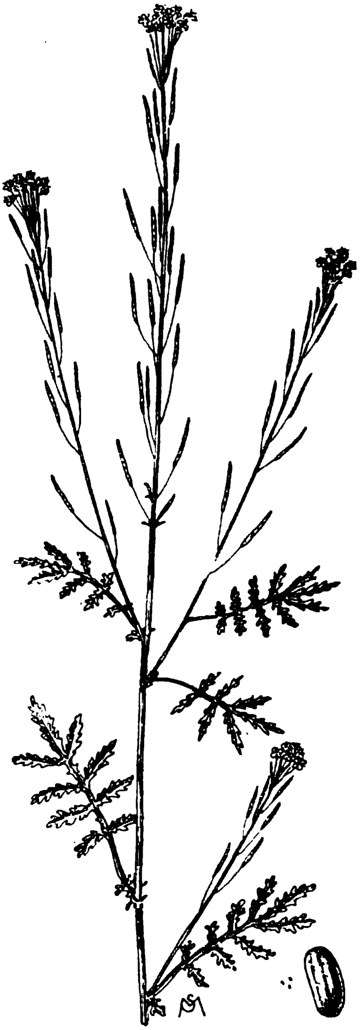


Fig. 107.

Green Tansy Mustard. ***Sisymbrium incisum*** **Engelm. Is causing trouble in the Canadian northwest and may be expected in Michigan.**

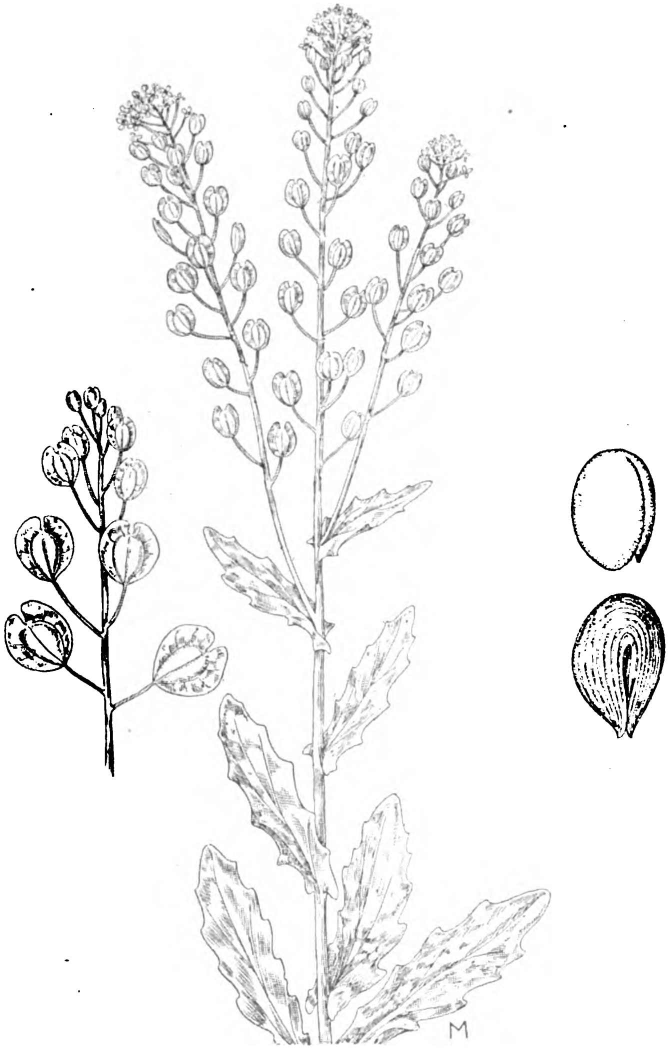


Fig. 108 (99).

Penny Cress. Stink Weed. *Thlaspi arvense* L. A smooth, erect annual, 15-40 cm. high; leaves sessile, the upper sagittate, flowers white; pods thin, flat, nearly circular, 8-16 mm. in diameter, deeply notched at the top. Waste places, ready for a very quick growth. Introduced from Europe. In the northwest a persistent enemy of the wheat grower; the seeds spoiling flour; also flavoring the mutton of sheep that eat the plant and when eaten by cows, giving a bad taste to milk.

ROSE FAMILY. ROSACEAE.

In the most comprehensive sense, this family of moderate size, of 1,500 species, is especially prominent in north temperate region, where it is most remarkable for the extraordinary number of valuable fruits and ornamental plants; it includes apples, pears, quinces, peaches, plums, cherries, almonds, raspberries, strawberries, roses, hawthorns, spiraeas and others; while its weeds are few and insignificant.

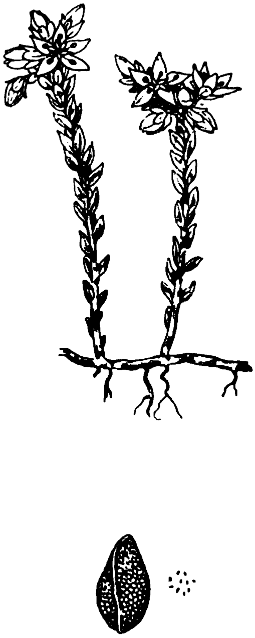


Fig. 109 (100).

Mossy Stonecrop. *Sedum acre* L. A smooth, densely tufted, spreading perennial, 3-8 cm. high; leaves sessile, yellowish green, entire, succulent, 3-5 mm. long; flowers yellow. A pretty little plant, escaped from cultivation, especially abundant in sandy land of cemeteries. Introduced from Europe.

ORPINE FAMILY. CRASSULACEAE.

A small family of about 500 species, widely distributed, mostly succulent herbs familiar in species of Live-for-ever and house-leek.

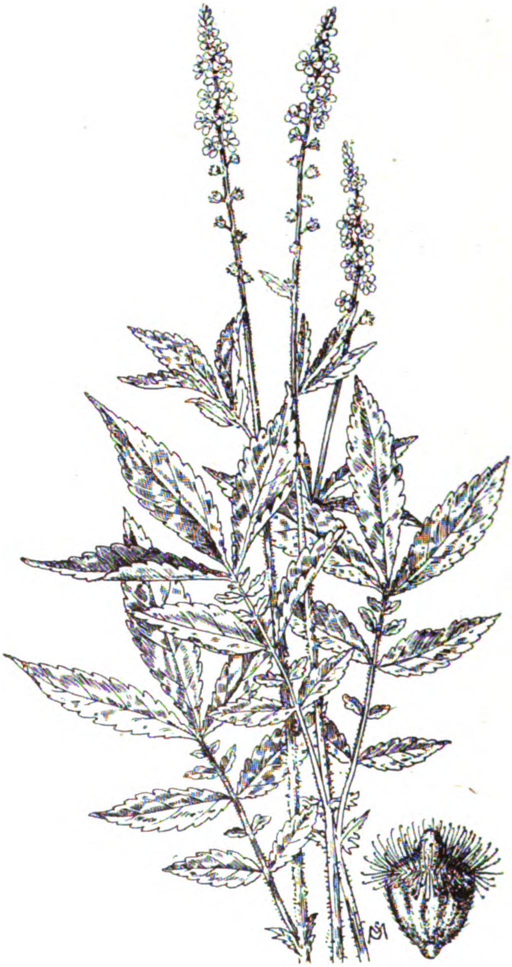


Fig. 110 (101).

Tall Hairy Agrimony. *Agrimonia gyrposepala* Wall. (*A. Eupatoria* in part, not L., *A. hirsuta* Bicknell.) A rough, hairy perennial. 70-120 cm. high; leaves large, thin, leaflets mostly 7, coarsely serrate, interposing segments mostly 3 pairs; flowers yellow; fruiting calyx nearly 1 cm. long; hooks long, widely spreading. Native to this country. Frequent in thin woods where the fruit damages wool.

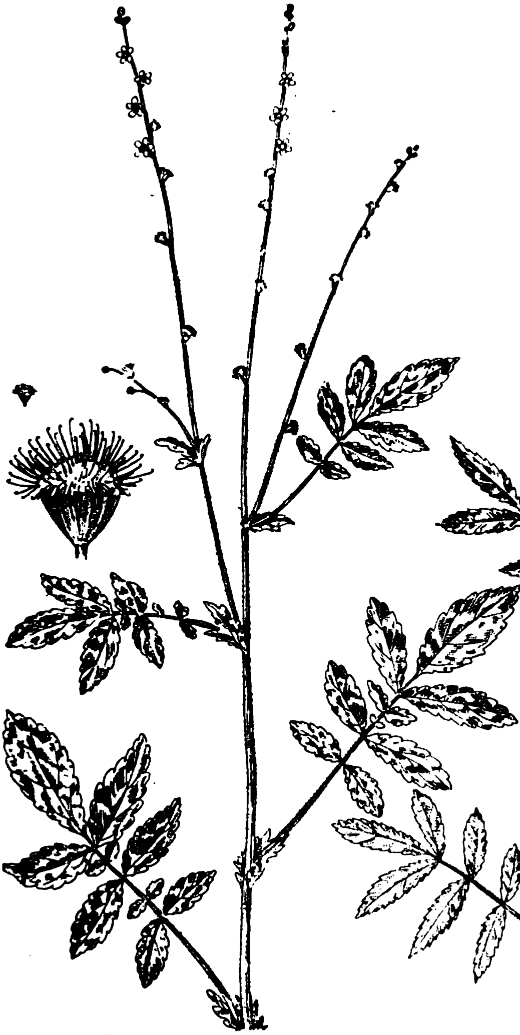


Fig. 111.

Soft Agrimony. *Agrimonia mollis* (T. & G.) Britton. Grayish-pubescent, root tuberous, 40-180 cm. high; larger leaflets 5-9, oblong, thickish, dull green, crenate to dentate, interposed leaflets mostly one pair; flowers yellow, fruit 4-5 mm. wide, slender bristles chiefly in a single row. Dry woods, troublesome to sheep and cattle. Native to this country.

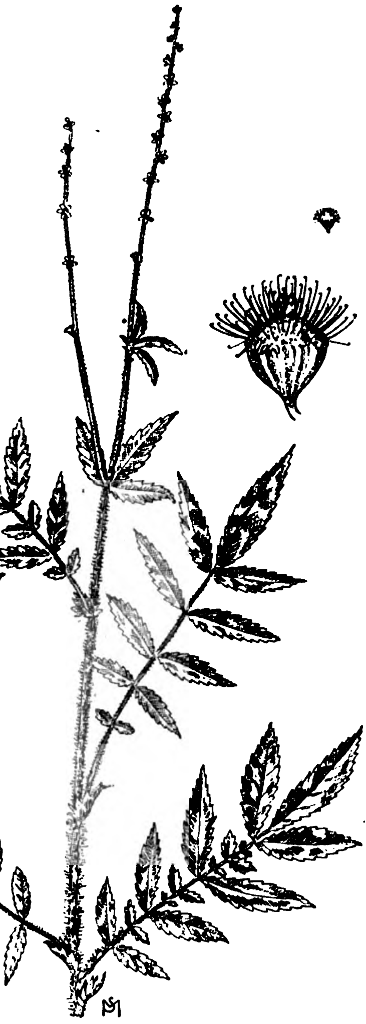


Fig. 112 (102).

Small-flowered Agrimony. *Agrimonia parviflora* Ait. A hirsute perennial, 70-120 cm. high; leaflets 9-17, crowded, lanceolate or narrower, rather thin, serrate, very glandular with many interposed leaflets of 2-3 different sizes; flowers numerous, 5-6 mm. in diameter, fruit small, loosely reflexed. Sandy shady places. Troublesome to sheep and cattle. Native to this country.

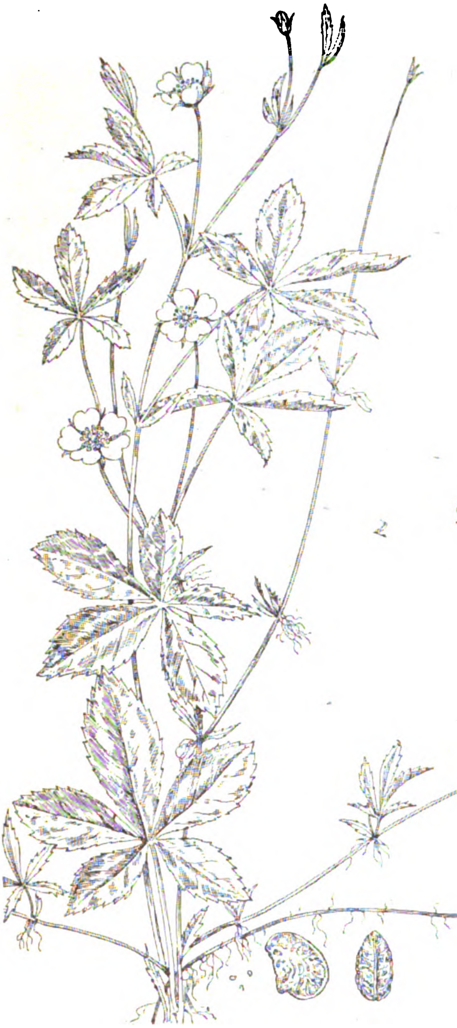


Fig. 113 (104).

Five-finger. A Cinquefoil. *Potentilla Canadensis simplex* (Michx.) T. & G. A herbaceous, slender, tufted, hirsute, perennial, spreading by numerous runners; leaflets 5, oblanceolate, serrate, apex obtuse, flowers single, yellow, achenes smooth.

Dry, sandy or thin soil. Native of this country.

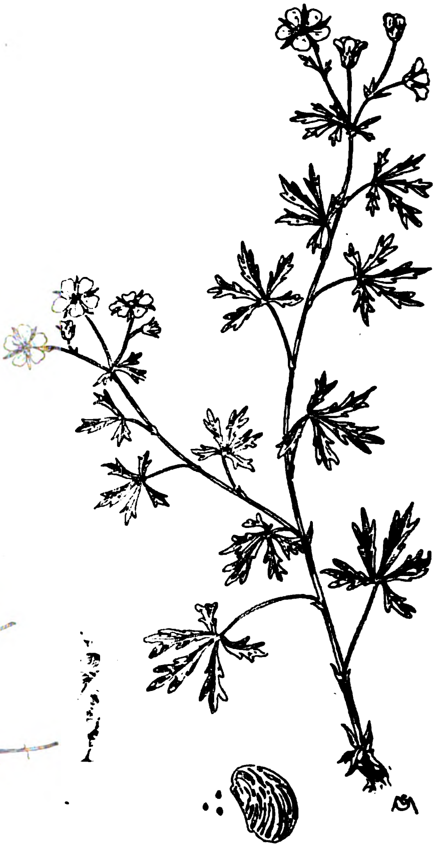


Fig. 114 (103).

Silvery Cinquefoil. *Potentilla argentea* L. Stems ascending, tufted, white-woolly, 10-40 cm. long; leaflets 5, oblanceolate, green above, white pubescent beneath; flowers rather large yellow. Dry, sandy, places introduced from Europe and perhaps native.

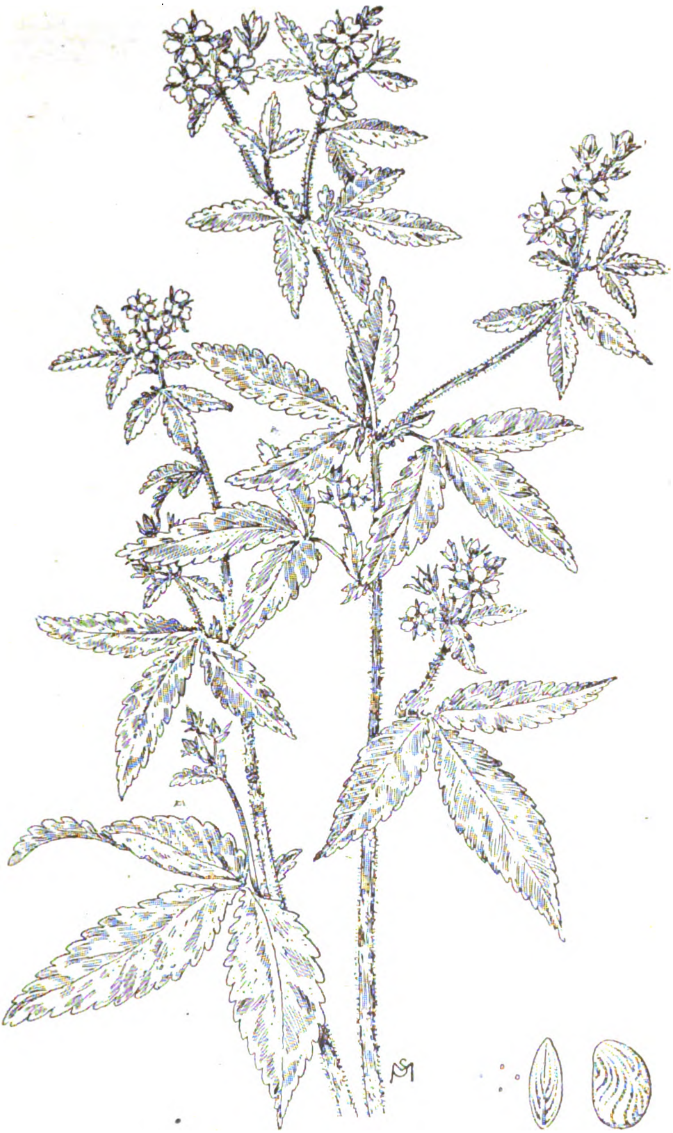


Fig. 115 (105).

Rough Cinquefoil. *Potentilla Monspeliensis* L. (*P. Norvegica* L.) An erect, stout, hirsute annual or biennial, 20-90 cm. high; leaves three-foliolate; leaflets obovate to oblanceolate; flowers yellow, usually rather densely cymose, calyx large. Open soil, dry or moist. Native, also found in Europe.

PULSE FAMILY. LEGUMINOSAE.

In the most comprehensive sense this immense family, second in size among seed-plants, includes fully 7,300 species, ranking in size next to the Compositae. The family is the most remarkable of any for the great number and variety of its economic plants. So far as known but few plants outside of this family possess roots which furnish abodes for microbes through whose operation free nitrogen becomes available as plant food. These abodes are familiar objects on roots and are known as tubercles or nodules. Plants of greatest value are the clovers, the alfalfas, beans, peas, lentils, lupines, vetches, cow peas, soy beans. In Leguminosae are found plants of great importance for furnishing medicines, timbers, dye stuffs, gums, for beauty of flowers and foliage. It furnishes a very small number of weeds.

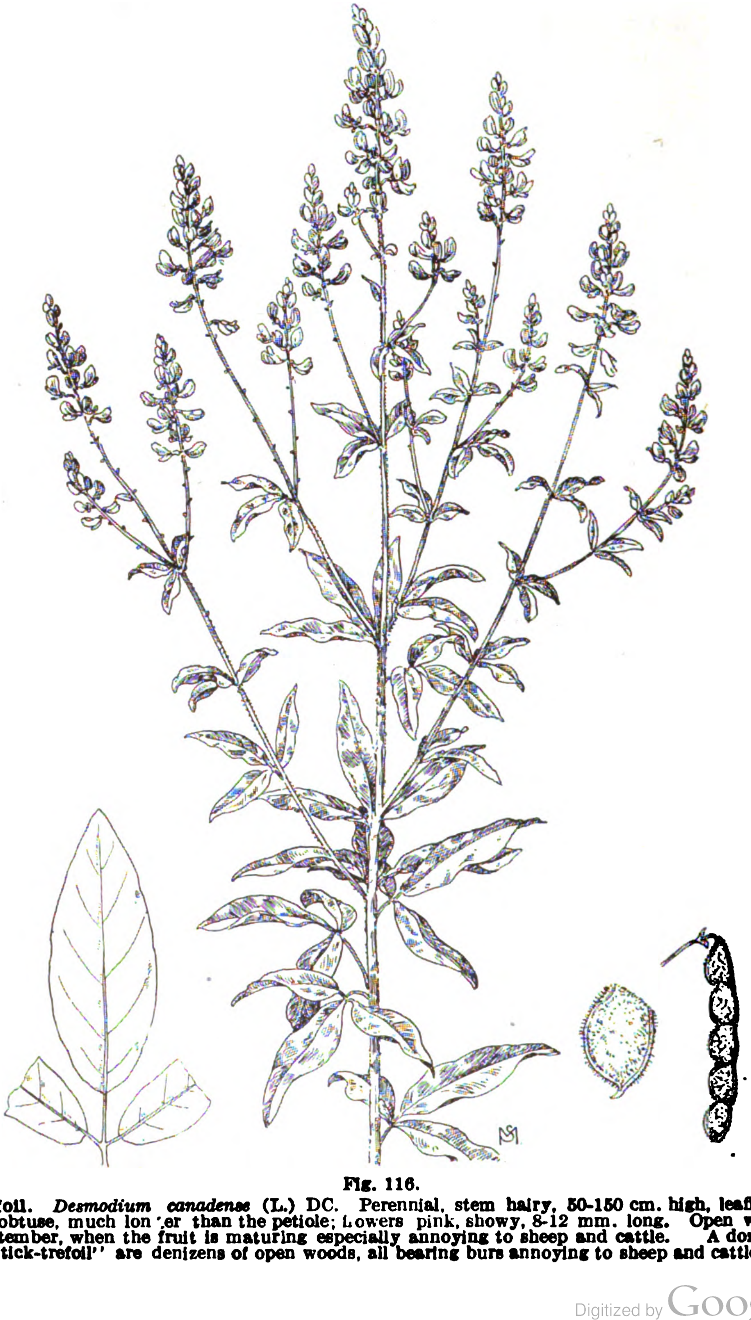


Fig. 116.

Tick-trefoil. *Desmodium canadense* (L.) DC. Perennial, stem hairy, 50-150 cm. high, leaflets oblong-lanceolate, obtuse, much longer than the petiole; flowers pink, showy, 8-12 mm. long. Open woods; common in September, when the fruit is maturing especially annoying to sheep and cattle. A dozen or more species of "tick-trefoil" are denizens of open woods, all bearing burs annoying to sheep and cattle.

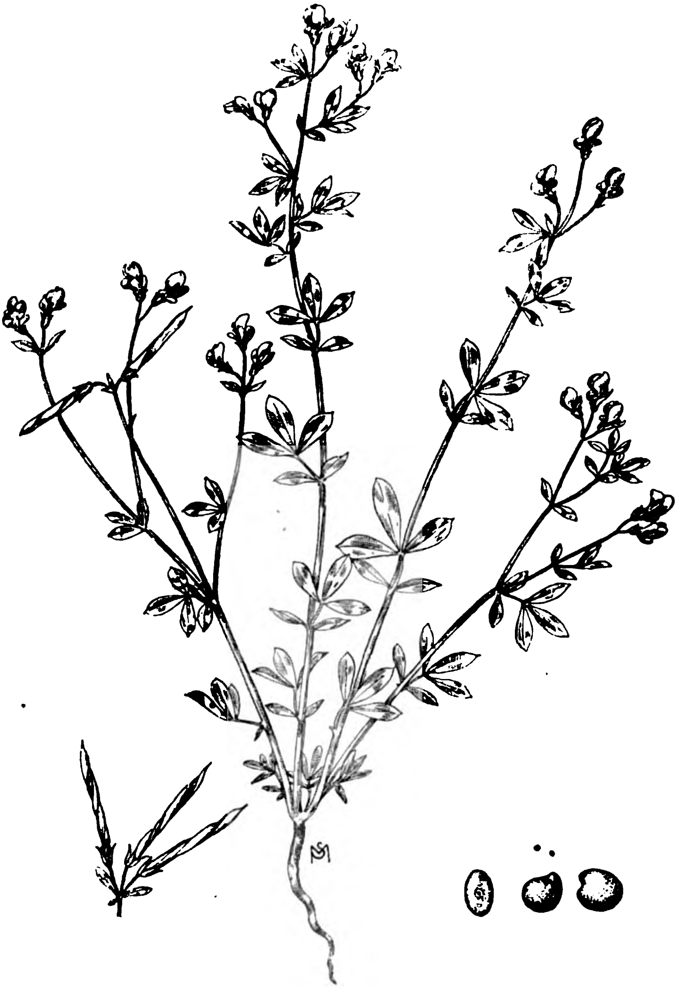


Fig. 117. (107.)

Bird's-foot Trefoil. Bloom-fell. *Lotus corniculatus* L. Perennial from a long root, stems slender, prostrate or ascending 5-60 cm. long; leaves hairy, leaflets three, each oblanceolate or obovate, stipules much resembling the leaflets; corolla yellow; pod linear, 2-3 cm. long, several seeded. Introduced from Europe and may soon be expected in Michigan.

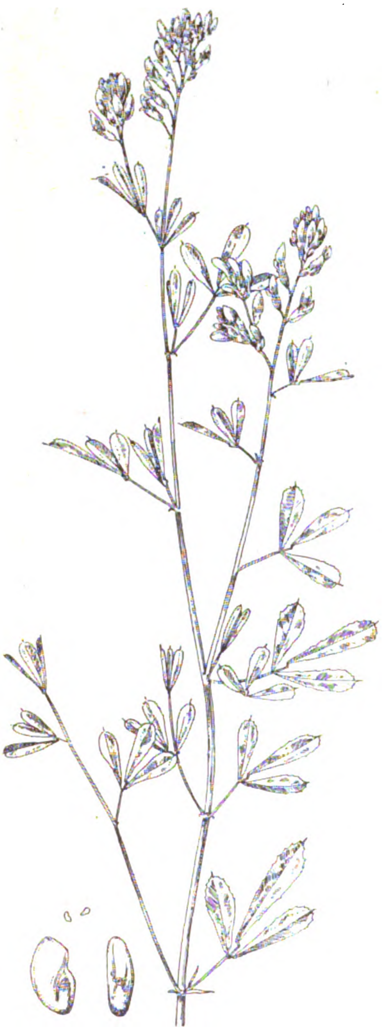


Fig. 118 (109).

Alfalfa. Lucerne. *Medicago sativa* L. Perennial from a deep stout root; stem 30-40 cm. high, nearly smooth, leaflets three, dentate, varying much in width; flowers bluish purple, rarely yellow or white; pod pubescent twisted into two or three spirals. Placed here not as a weed but for comparison.

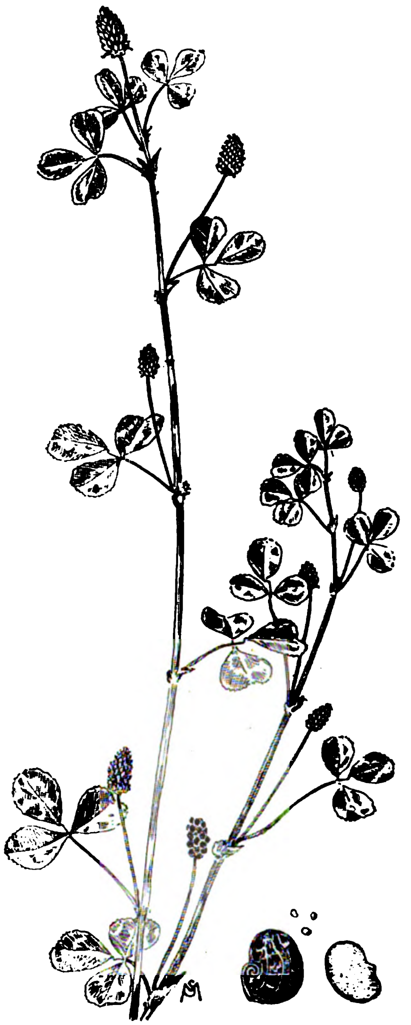


Fig. 119 (108).

Black Medick. Nonesuch. *Medicago lupulina* L. Annual, minutely pubescent mostly prostrate, spreading, 30-60 cm. long; leaflets three, obovate or circular, variously toothed; flowers yellow, fruit in heads, pod curved into a spiral, one-seeded. Introduced from Europe and often found in Michigan. The seeds are not unfrequently used to adulterate those of Alfalfa.

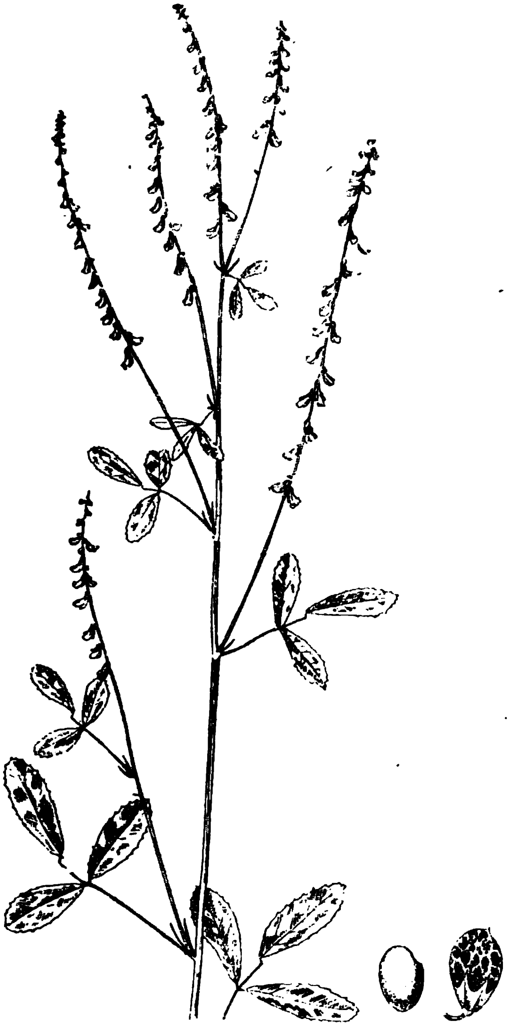


Fig. 120 (110).

White Sweet Clover. *Melilotus alba* Desv. Usually biennial, erect, smooth 90-300 cm. high; leaflets three, serrate, varying much in width, 10-20 mm. long, not twisted.

Somewhat extensively sown as a bee plant along highways of the state. Considerably resembling alfalfa, but may be distinguished by smelling of the crumpled leaves, those of Melilotus resembling the odor of the tonka bean. Offensive to cattle, which may be educated to eat it. Valuable to plow under for enriching the land. Seeds used to adulterate those of Alfalfa. Introduced from Europe.

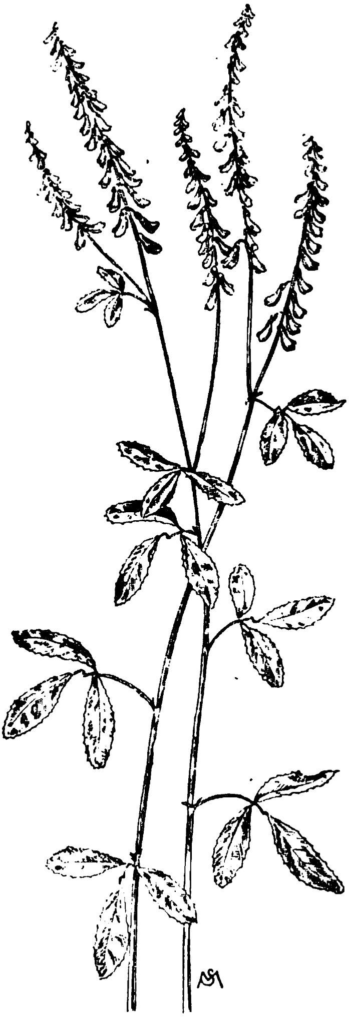


Fig. 121.

Yellow Sweet Clover. *Melilotus officinalis* (L.) Lam. Resembles the former; flowers yellow; thriving on moist clay soil, not much of a weed in Michigan.

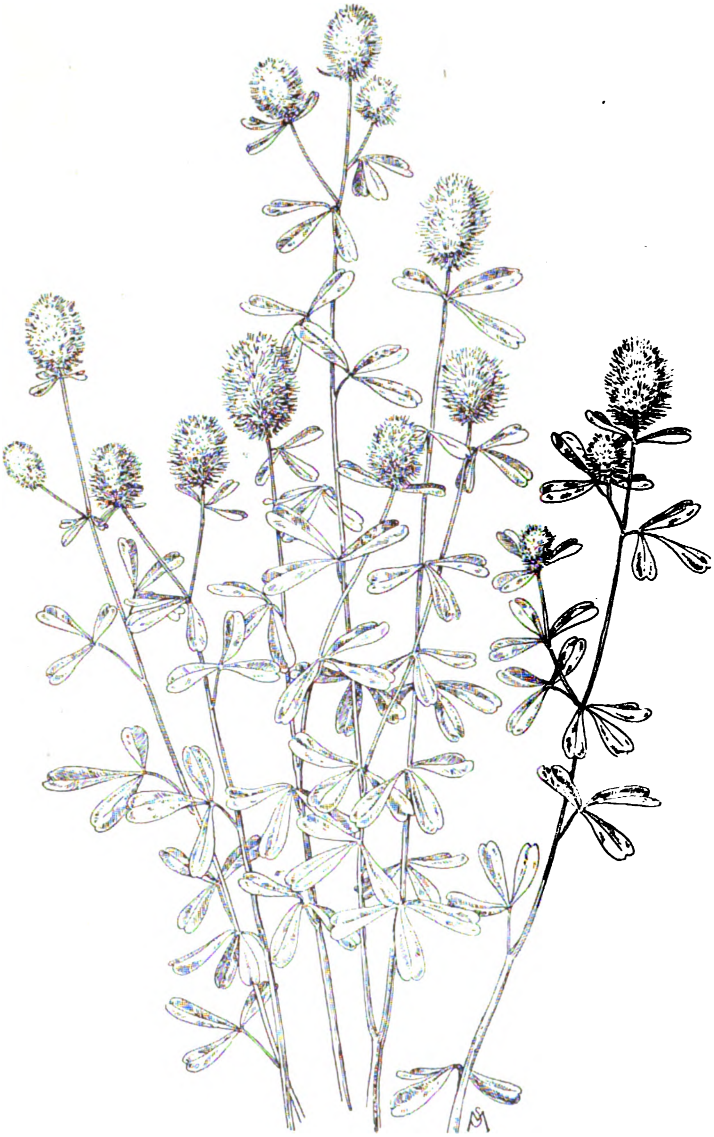


Fig. 122.

Rabbit-foot Clover. *Trifolium arvense* L. A slender, erect, silky, hairy annual, 15-25 cm. high; leaflets three, sessile, narrowed at the base; calyx silky; corolla whitish, Not common nor troublesome. Sandy, barren soil. Introduced from Europe. If eaten by horses, the flower heads collect into balls, closing the intestines.

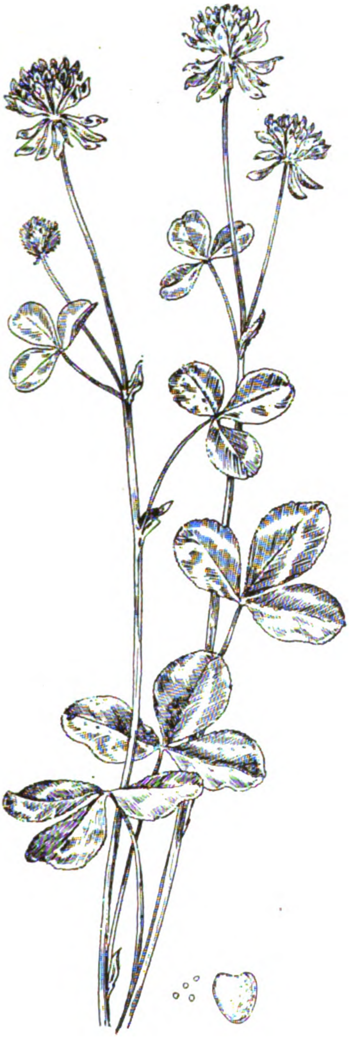


Fig. 123 (111).

Alsike Clover. *Trifolium hybridum* L. Biennial, perennial (?), smooth, stems weak, 30-60 cm. long; leaves with long petioles, leaflets three; obovate, narrowed at the base, serrulate; heads of flowers without an involucre, peduncle long, corolla pinkish white. Never a weed but placed here for the purpose of comparison.

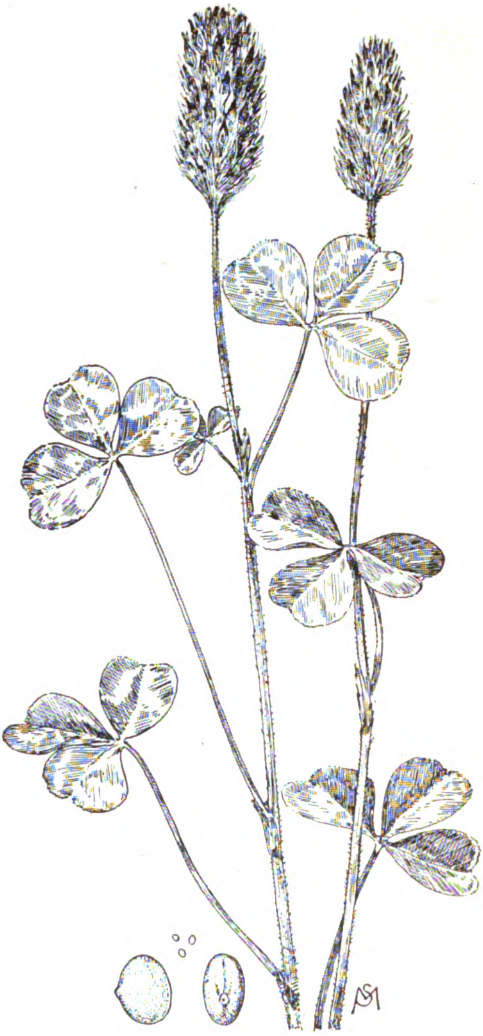


Fig. 124 (112).

Crimson Clover. Scarlet Clover. Italian Clover. *Trifolium incarnatum* L. Annual, erect, soft, pubescent, 15-90 cm. high; leaves long petioled, leaflets nearly sessile, obovate, narrowed at the base, denticulate; heads terminal becoming spikes, 2-5 cm. long; flowers sessile, calyx hairy, corolla crimson, very showy.

Dangerous to feed horses, as the hairy calyces form balls in the stomach and clog the intestines Not a weed but included here for comparison. Introduced from Europe.

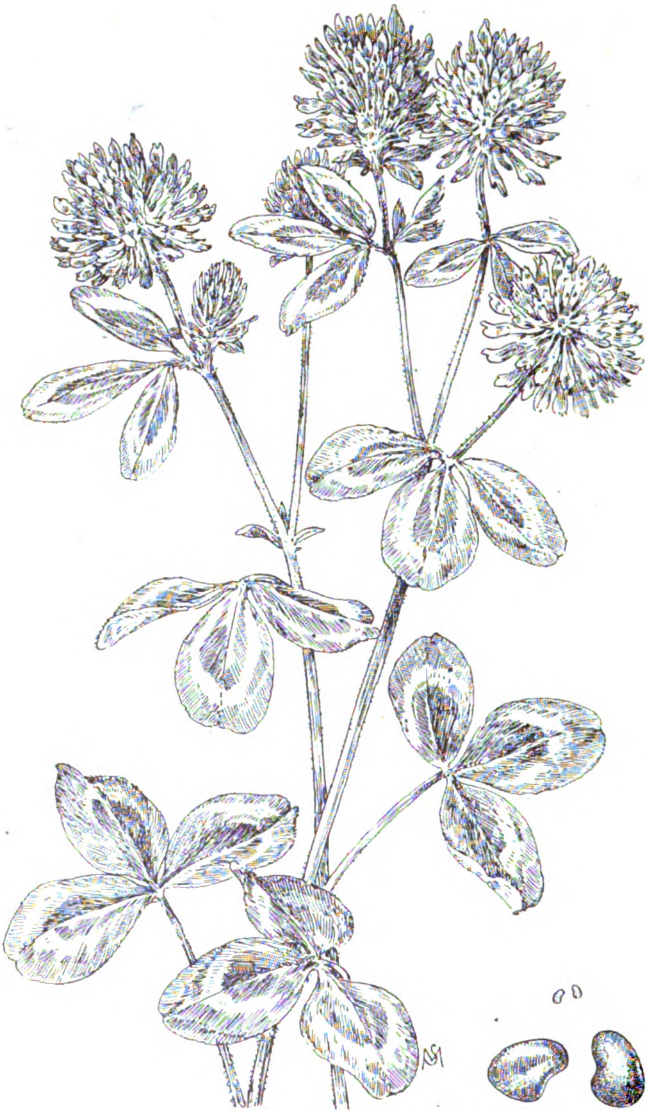


Fig. 125 (113).

Red Clover. *Trifolium pratense* L. A well-known useful plant, drawings inserted here for comparison. Introduced from Europe.

Mammoth Clover. A race obtained by selection from red clover from which it gradually merges with all intermediate grades. The seeds of this and red clover are indistinguishable.

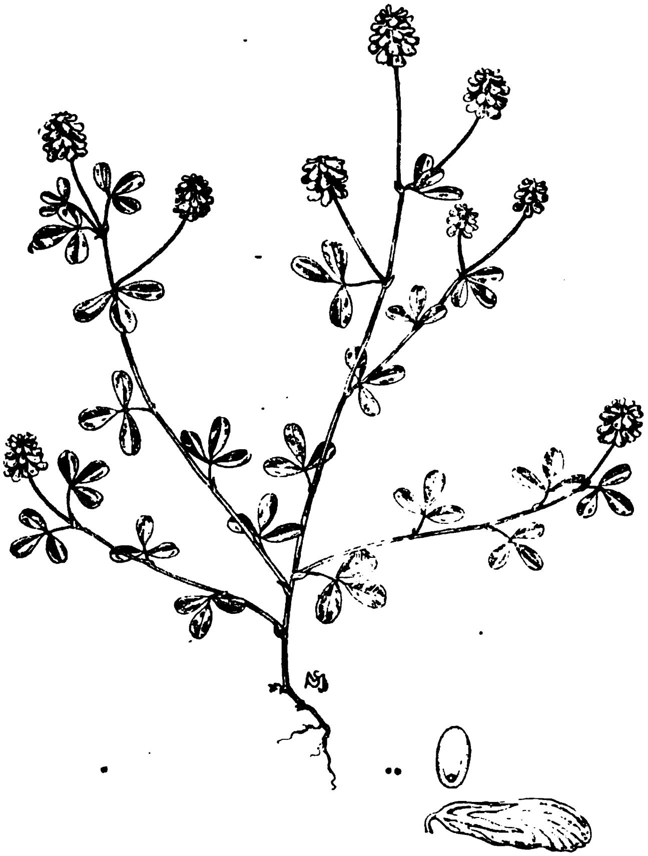


Fig. 126 (114).

Low Hop Clover. *Trifolium procumbens* L. A low, bushy annual, 10-20 cm. high; leaflets obovate, wedge-shaped, finely toothed, the terminal one distinctly stalked; heads globose; flowers yellow, at length reflexed, corolla striate, becoming brown when dry. Large plants sometimes become tumble-weeds. Introduced from Europe.

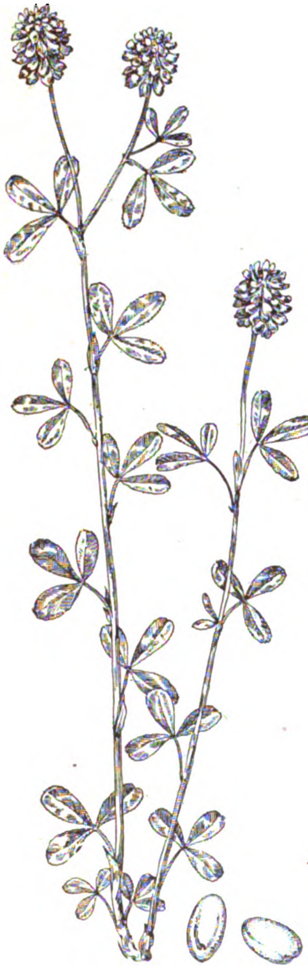


Fig. 127.

Yellow Clover. Hop Clover. *Trifolium agrarium* L. Scarcely a weed, much resembles the preceding; the three leaflets of this are all sessile while the center one of the preceding is raised on a very short stem.

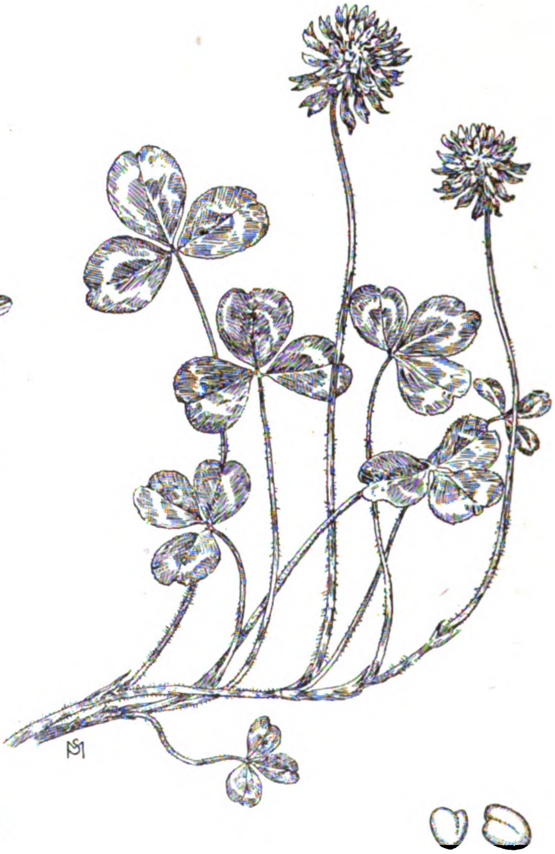
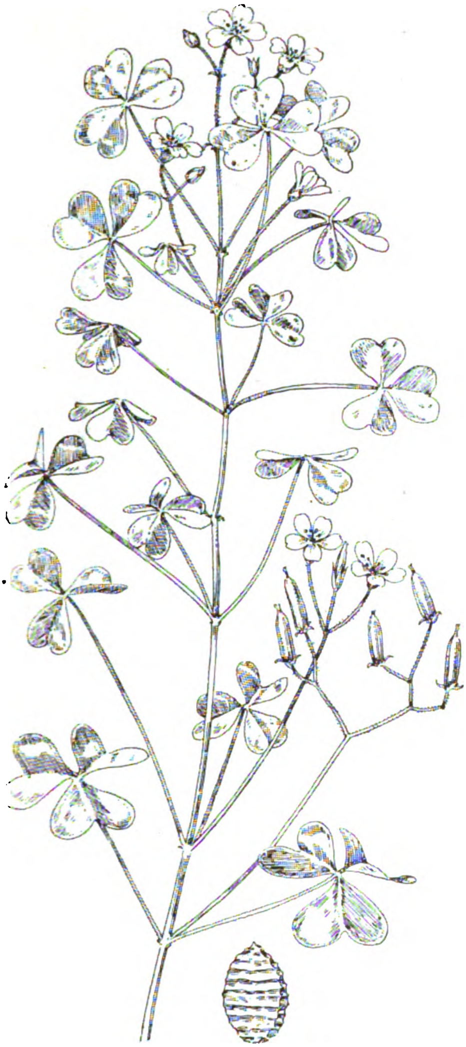


Fig. 128 (115).

White Clover. Dutch Clover. *Trifolium repens* L. A perennial, creeping by the reclined branches which root at the joints, 10-30 cm. long; leaves with long stems, leaflets three, all from the same point, obovate, toothed; heads globose, on long stems; flowers white, the stems finally reflexed when the seeds mature. Scarcely a weed; noticed here for convenience of comparisons. Introduced from Europe.

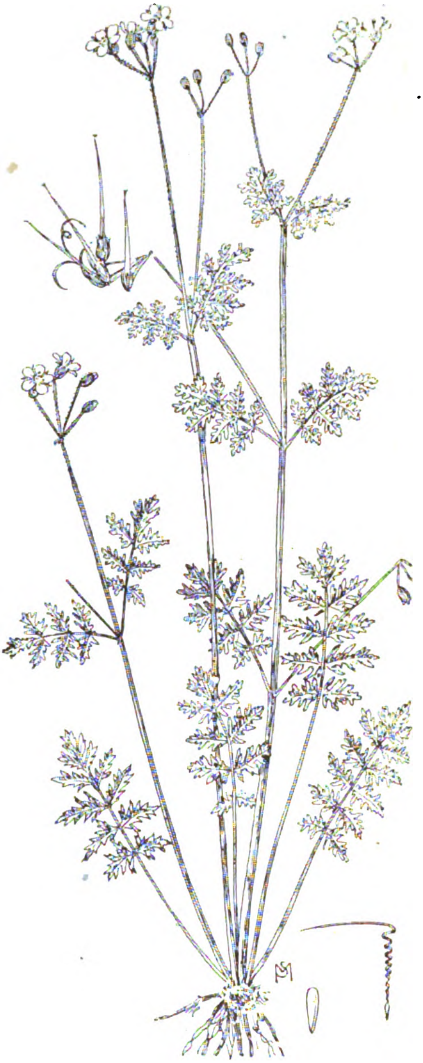


WOOD SORREL FAMILY. OXALIDACEAE.

A small family containing about 270 species, with clover-like leaves, sour to the taste.

Fig. 129.

Yellow Wood Sorrel. *Oxalis corniculata* L. (*Oxalis cymosa.*) Annual or perennial, pale green herbs, spreading, 15-30 cm. high; leaflets three, closing when touched or at night; flowers yellow; capsule five-sided, 15-22 mm. long. Woods and fields, native to this country.



GERANIUM FAMILY. GERANIACEAE

A small family of herbs or slightly woody plants of 450 species, most abundant in South Africa, where thrive many of the species now in cultivation.

Fig. 130 (116).

Storks bill. Alfilaria. *Erodium cicutarium* (L.) L'Her. A spreading, hairy annual, 15-30 cm. high; leaves pinnate, the leaflets more or less lobed; petals purple or pink. Introduced from Europe.

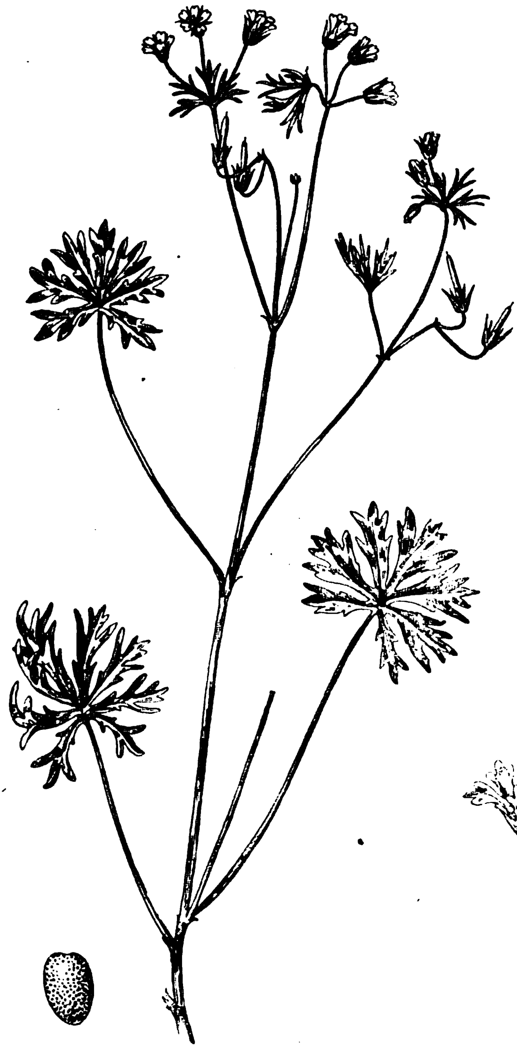


Fig. 131 (117).

Cut-leaved Crane's Bill. *Geranium dissectum* L. A slender, spreading annual, 10-30 cm. high; leaves deeply cleft into narrow segments; petals purple; lobes of capsule and beak pubescent, seeds shot from the parent plant.

Introduced from Europe; still scarce in Michigan.

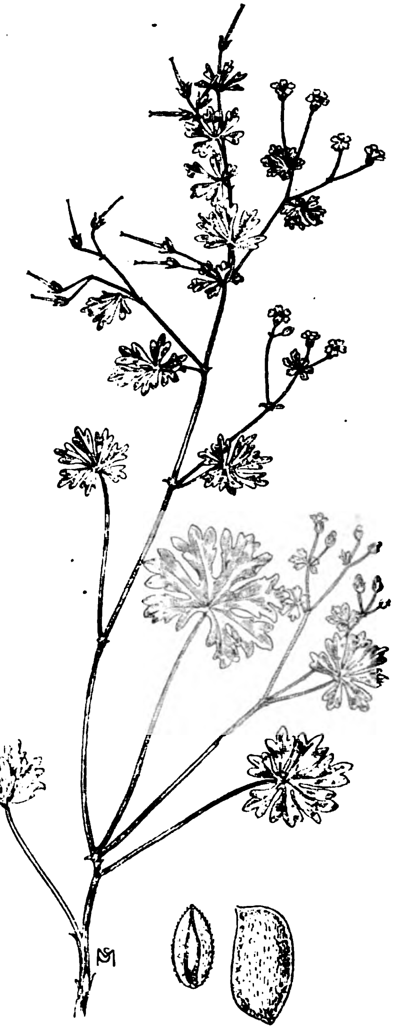


Fig. 132 (118).

Small-flowered Crane's Bill. *Geranium pusillum* Burm. f. A weak, slender, spreading, pubescent annual, 10-40 cm. high; leaves circular in outline, deeply divided into 7-9 lobes; corolla pale purple, petals minutely notched; lobes of capsule hairy, not wrinkled. Seeds well scattered by the parent plant. Introduced from Europe. A "nasty" little thing.

SPURGE FAMILY. EUPHORBIACEAE.

Plants usually pervaded by an acrid, milky juice; flowers too difficult to understand by any one not well trained; 4,000 species with wide distribution. Croton, Poinsettia, Ricinus are ornamental; a few are weeds.

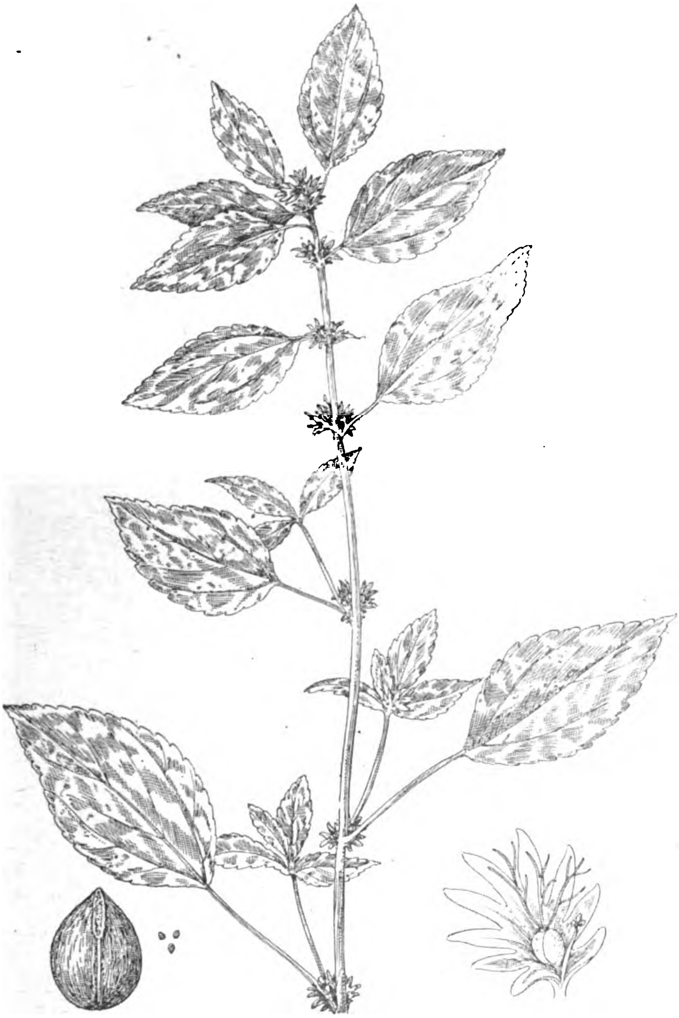


Fig. 133 (119).

Three-Seeded Mercury. *Acalypha Virginica* L. An erect, dark green or purplish annual, 20-60 cm. tall; leaves mostly ovate, coarsely serrate; flowers monoecious, inconspicuous; the plant has a weedy aspect.
A native widely distributed in open places.

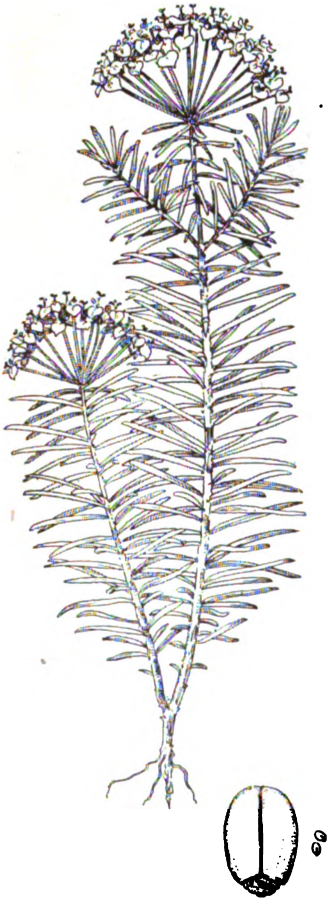


Fig. 134 (120).

Cypress Spurge. *Euphorbia Cyparissias* L. A densely clustered perennial, 10-30 cm. high, milky juice profuse; leaves abundant, very narrow, 2-3 cm. long; flowers and bracts in yellowish clusters, conspicuous. Escaped from cultivation, especially abundant in sandy cemeteries. Introduced from Europe.

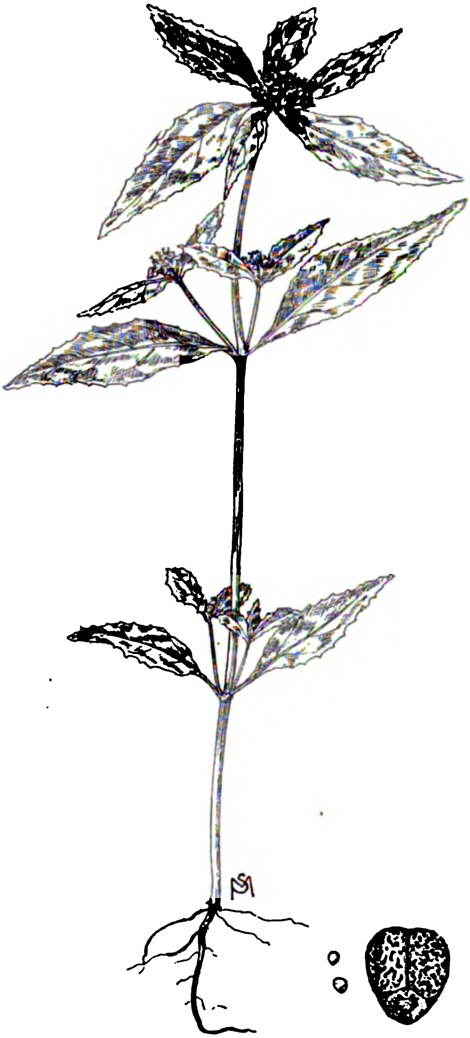


Fig 135. (121).

Toothed Spurge. *Euphorbia dentata* Michx. An erect, dull green, pubescent annual, 25-100 cm. high; leaves petioled, ovate, coarsely toothed, 4-8 cm. long, the upper often paler at the base.

A native thriving in rich soil, oftener south of Michigan.

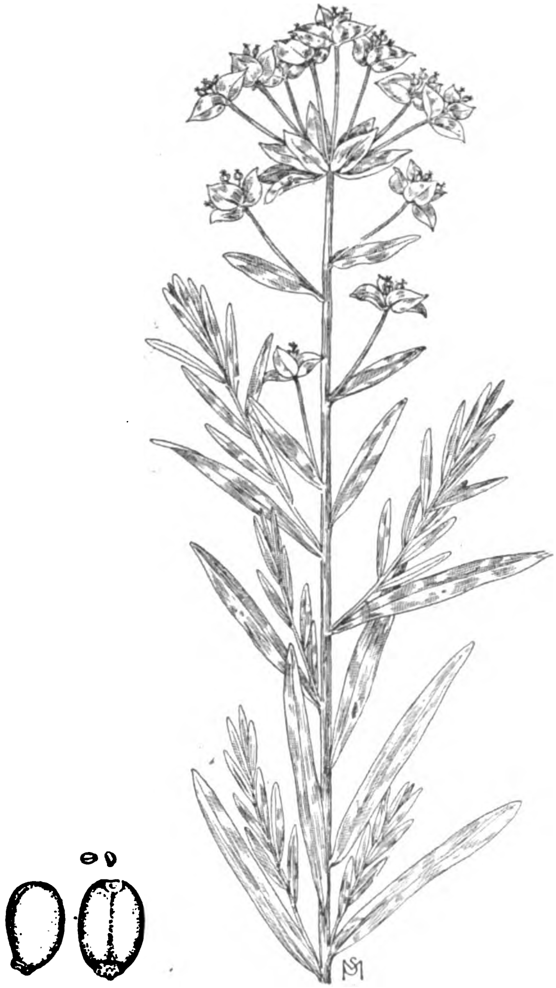


Fig. 136 (122).

Leafy Spurge. *Euphorbia Esula* L. A smooth, erect, perennial, 30-120 cm. high, spreading by rootstocks; leaves numerous, lanceolate; flowers clustered in umbels Waste places, introduced from Europe.

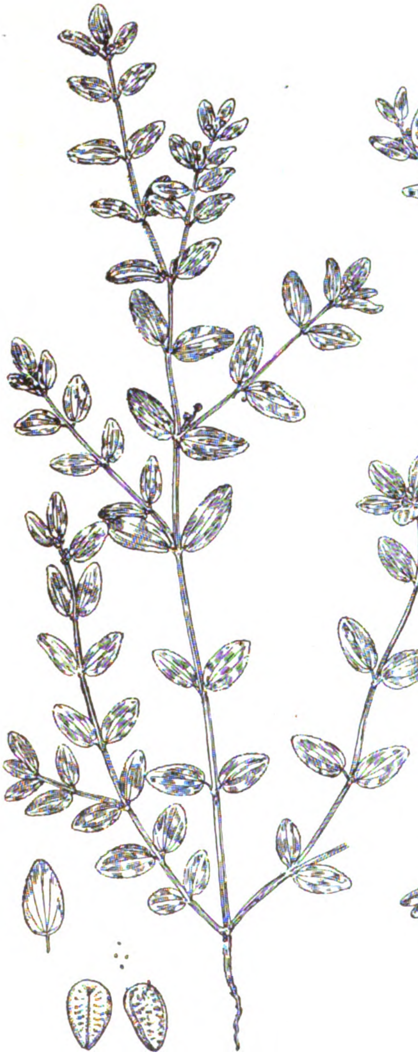


Fig. 137 (123).

Euphorbia hirsuta (Torr). Wiegand. A spreading, hairy annual, branching at the base, 20-30 cm. high; leaves 8-14 mm. long, oblong. Widely scattered.

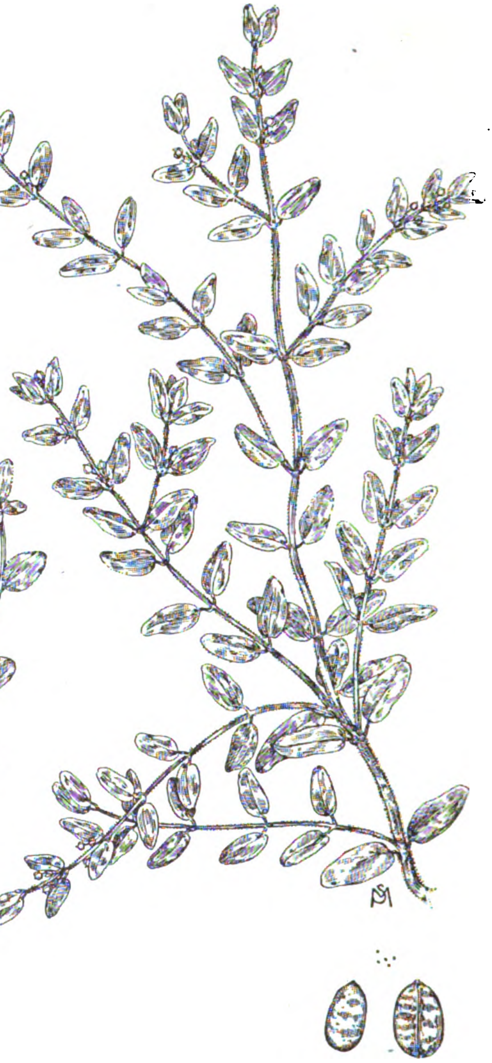


Fig. 138 (124.)

Spotted Spurge. *Euphorbia maculata* L. A prostrate, pubescent, dark green annual, 3-15 cm. long, often dark red; leaves usually blotched, oblong, obtuse, very unequal, lobed at the base. Not starting till the weather becomes warm. A native very widely distributed.

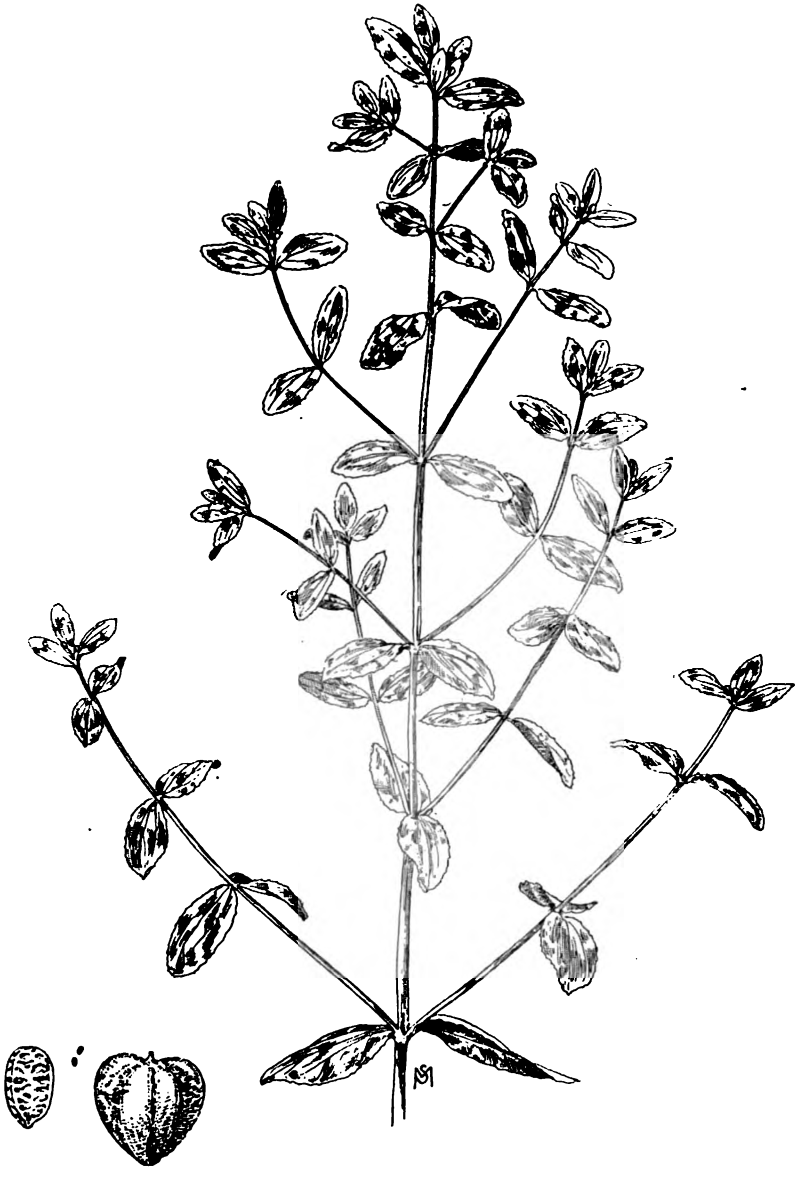


Fig. 139 (125).

Upright Spotted Spurge. *Euphorbia Preslii* Guss. (*Euphorbia nutans* Lag.) Annual, mostly smoooth, ascending, spreading, recurved, 15-60 cm. long; leaves oblong, or narrower, often curved to one side, serrate, usually with a red blotch and red margins, lobes unequal.

Native at the east, introduced into Michigan mixed with seeds of red clover.

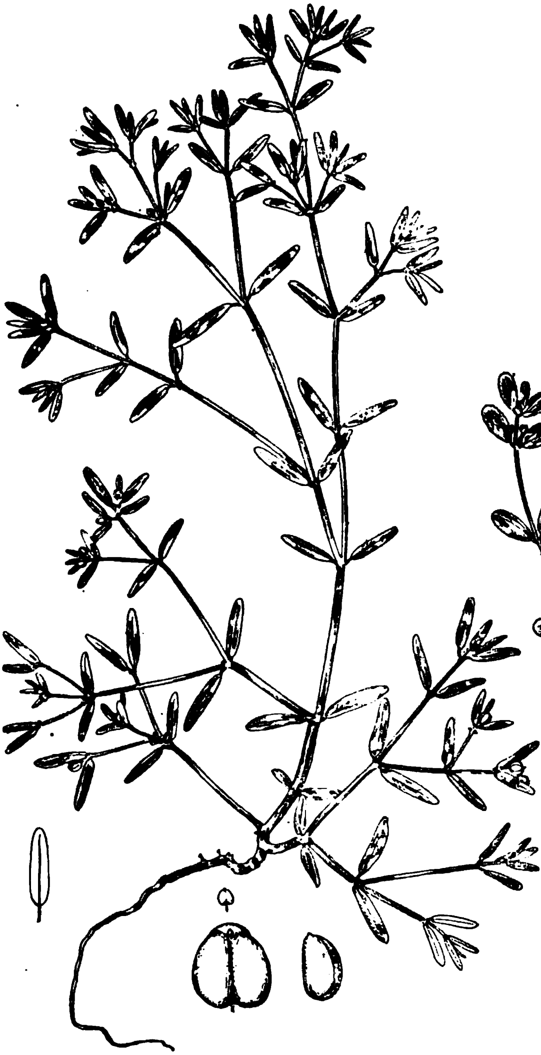


Fig. 140.

Seaside Spurge. *Euphorbia polygonifolia* L. A slender, smooth, pale green, prostrate annual, 7-10 cm. long; leaves linear, fleshy, obtuse, sandy shores of the Atlantic, and the Great Lakes, and more or less inland.

Spurge *Euphorbia.* Half a dozen other species have been found in the state, some of which may become troublesome at any time.

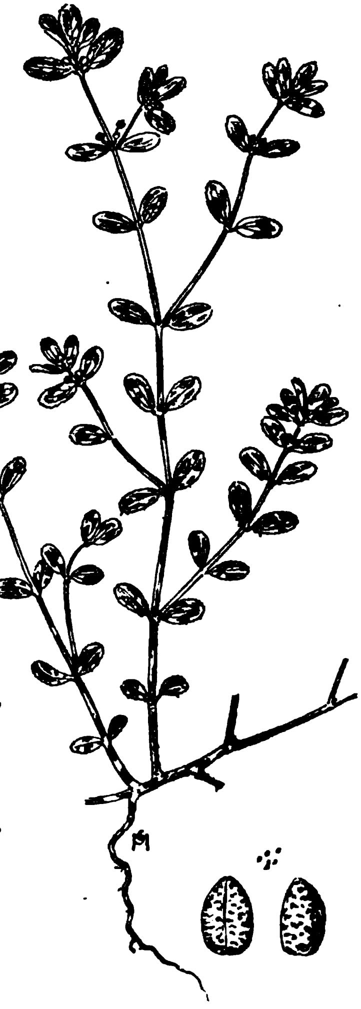


Fig. 141 (126).

Thyme-leaved Spurge. *Euphorbia serpyllifolia* Pers. A smooth, slender, prostrate, spreading annual, dark green or becoming red, 10-30 cm. long; leaves oblong, sharply serrulate, 6-12 mm. long often with a red spot.

A native widely scattered, thriving on sandy soil.

SUMACH FAMILY. CASHEW FAMILY. ANACARDIACEAE.

Trees or shrubs pervaded by resinous or milky, acrid juice; fruit mostly in the form of a drupe. Some of the sumachs are occasionally annoying owing to the fact that the plants spread rapidly by long sprouting roots, but the chief reason for notice here is the fact that some of them are very poisonous to the touch to some persons; about 400 species mostly confined to warm regions.

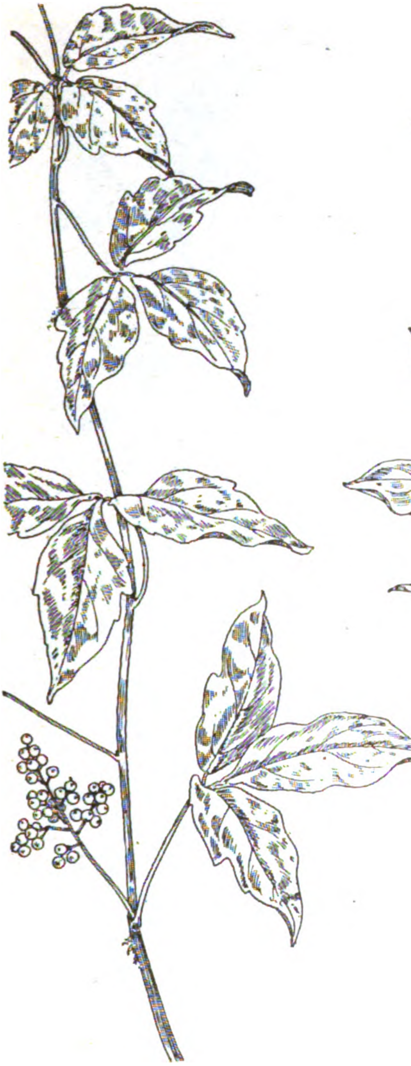


Fig. 142 (127).

Poison Ivy. *Rhus Toxicodendron* L. A bushy vine climbing by rootlets over walls and up the trunks of trees; leaves compound, consisting of three leaflets, well shown in the illustration. Very poisonous to the touch to many persons. A rather attractive plant. Native to this country.

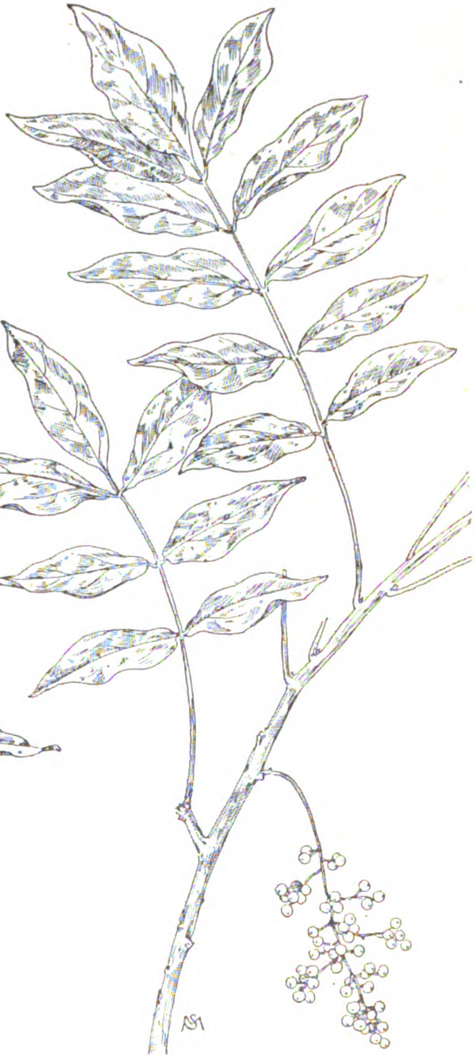


Fig. 143.

Poison Elder. Poison Sumach. [*Rhus Vernix* L. A shrub or small tree, 2-5 m. high; leaflets 7-15, obovate-oblong, entire. Thriving in swamps where the leaves assume very attractive tints in autumn. To many persons very poisonous to the touch. Native to this country.

MALLOW FAMILY. MALVACEAE.

Herbs or shrubs, pervaded by an innocent mucilaginous sap. Some species are ornamental, such as Abutilon, Althaea, Hibiscus; a few are weeds. Indian Mallow affords tough bark for cordage.

A small family widely distributed in tropical and temperate regions.

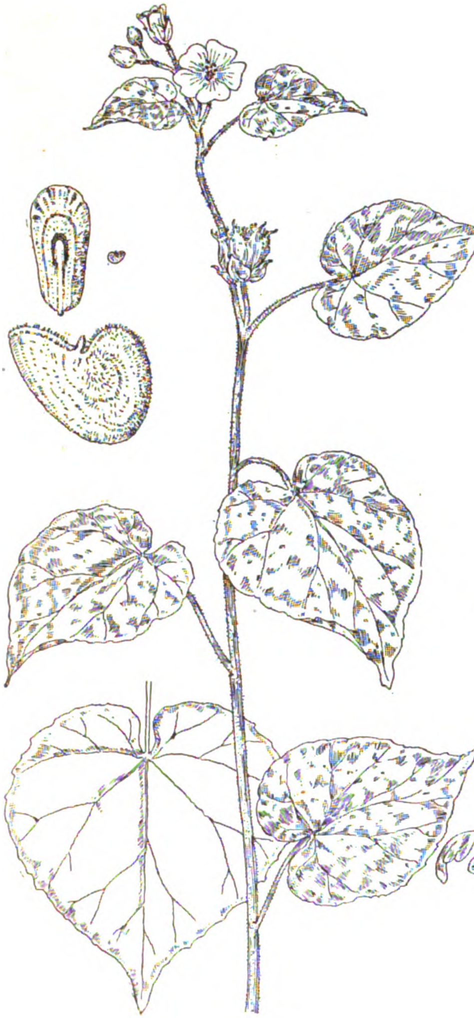


Fig. 144 (128).

Velvet Leaf American Jute. *Abutilon Theophrasti* Medic. (*Abutilon Avicennae* Gaertn. *Abutilon Abutilon* Rusby.) A finely velvety annual, 60-120 cm. high; leaves roundish, heart-shaped, velvety; corolla yellow; heads of fruit, 2-2.5 cm. broad; pistils 12-15, beaked, opening with age. Naturalized from Southern Asia, occasionally found in the southern peninsula. The plant likes warm weather and deep rich soil.

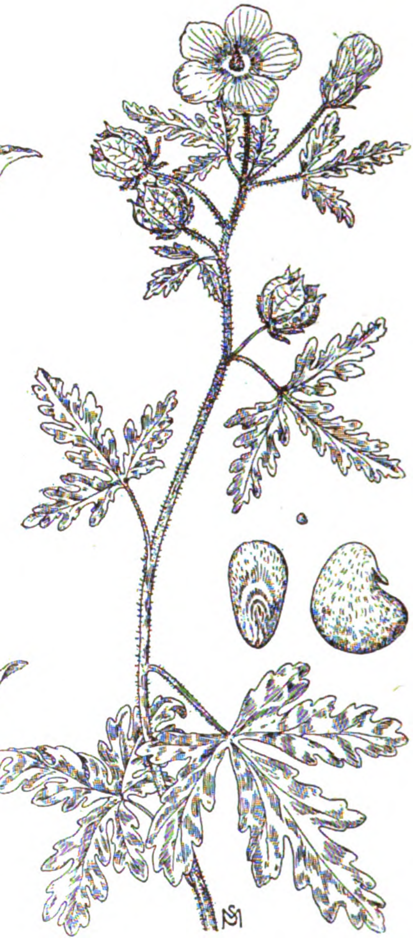


Fig. 145 (129).

Bladder Ketmia. *Hibiscus Trionum* L. A low rather hairy annual; upper leaves three-parted; flowers pale yellow with a purple eye; calyx in fruit inflated, five-winged.

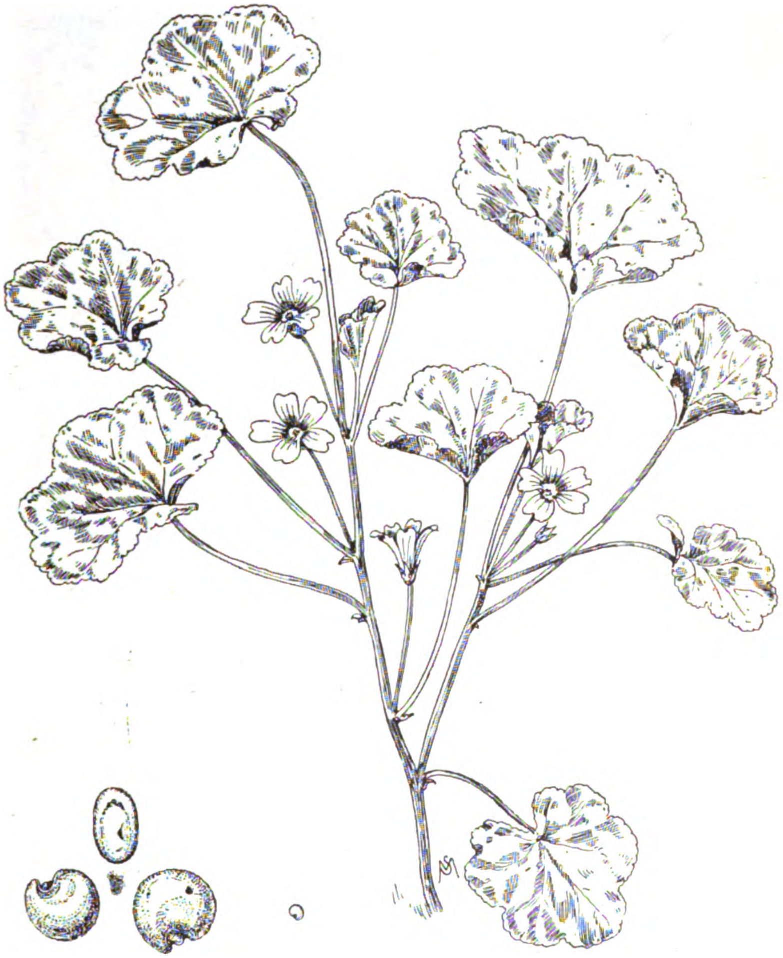


Fig. 146 (130).

Common Mallow. Cheeses. *Malva rotundifolia* L. A procumbent biennial or perennial, with a deep tap root; stems 10-30 cm. long; leaves round, heart-shaped, petioles very long; corolla white or pale blue; pistils crowded into a circle about 15 in number. Introduced from Europe; becoming common.

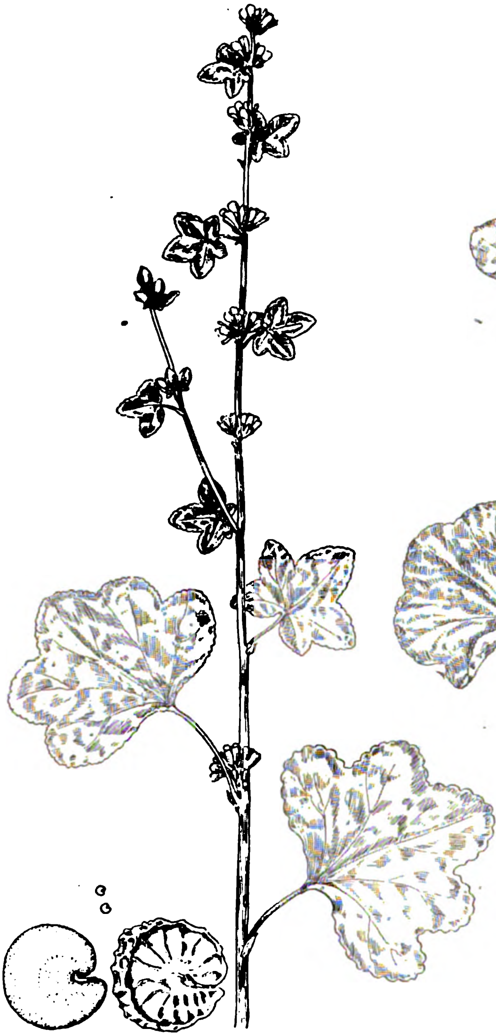


Fig. 147 (131).

Whorled Mallow. *Malva verticillata* L. An erect annual, 1-2 m. high, leaf-blades nearly circular; flowers small white, crowded. Introduced from Europe to the West and from the West to Michigan.

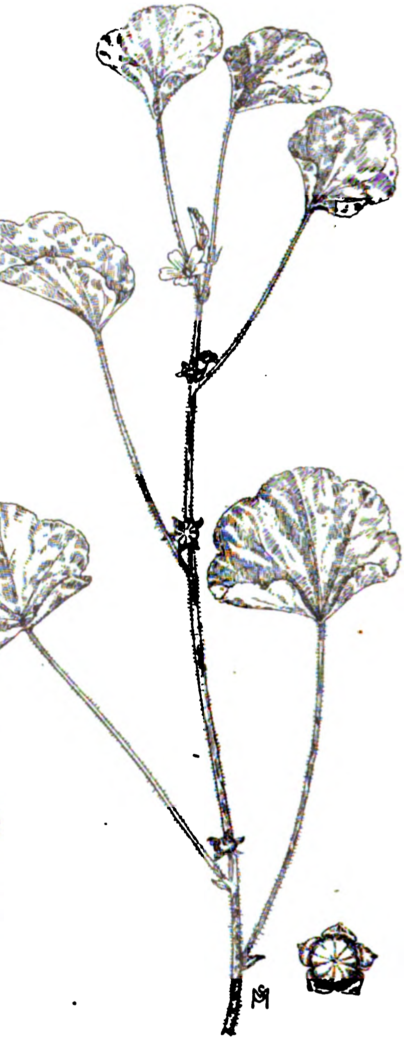


Fig. 148.

Small-flowered Mallow. *Malva parviflora* L. One introduced from the West and grown for two years at the Agricultutal College, perhaps now exterminated. It may come again at any time with seeds of clover or alfalfa.

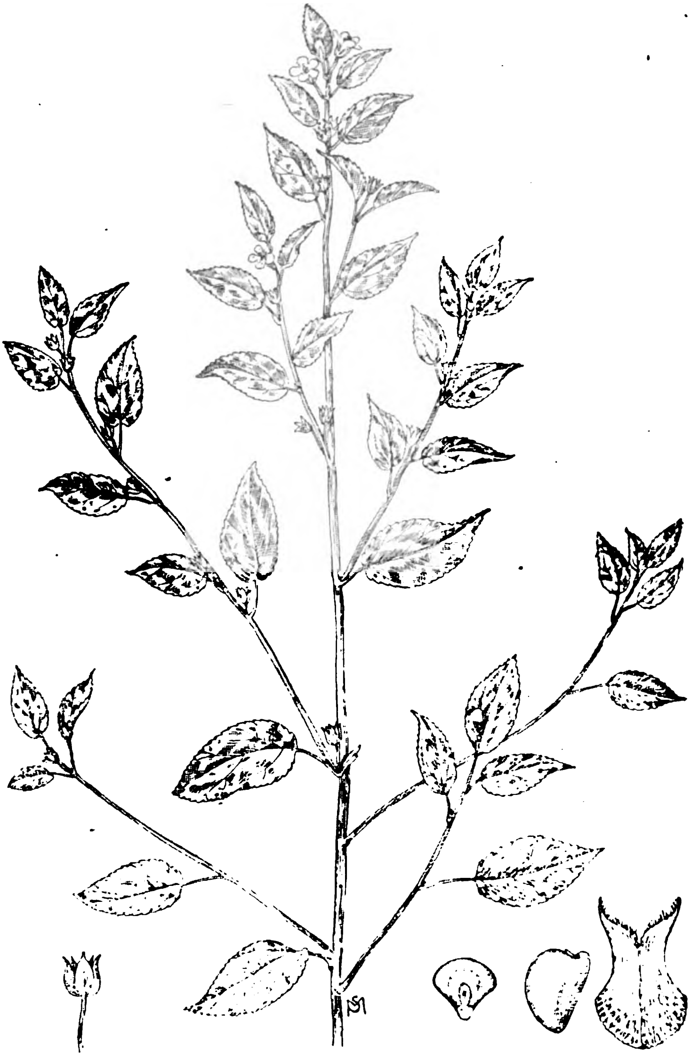


Fig. 149 (132).

Prickly Sida. *Sida spinosa* L. An erect, softly pubescent annual, 30-60 cm. high; leaves mostly ovate, serrate with long stems; flowers small yellow; pistils five-jointed together forming an egg-shaped fruit; each splitting at the top into two beaks. Apparently a native in some portion of the United States. Thriving well southward.

ST. JOHN'S-WORT FAMILY. HYPERICACEAE.

Herbs or shrubs, leaves with pellucid dots, punctate or black. A small family consisting of about 280 species, native of temperate and warm regions.

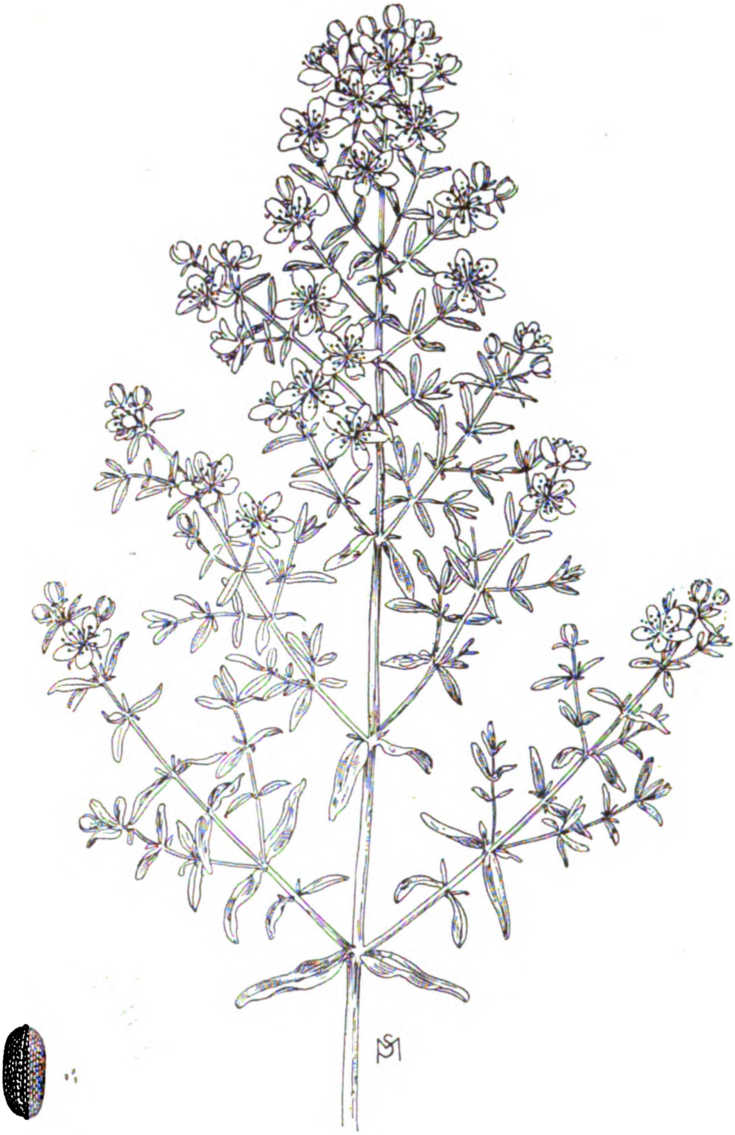
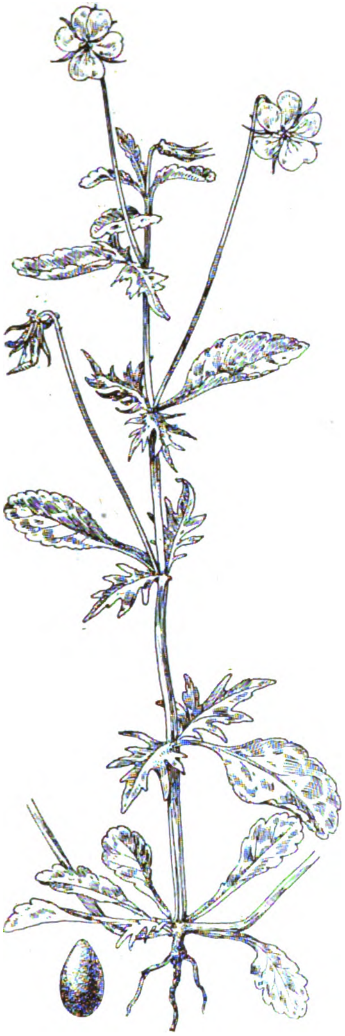


Fig. 150. (133).

Common St. John's-wort. *Hypericum perforatum* L. A herbaceous perennial. 30-60 cm. high, spreading by runners at the base; leaves sessile, elliptical with pellucid dots; petals deep yellow, black-dotted along the margins, twice as long as the sepals; stamens numerous; pistil three-celled. Rather bad in old meadows and roadsides. Introduced from Europe. Of eighteen or more native species none are weeds.



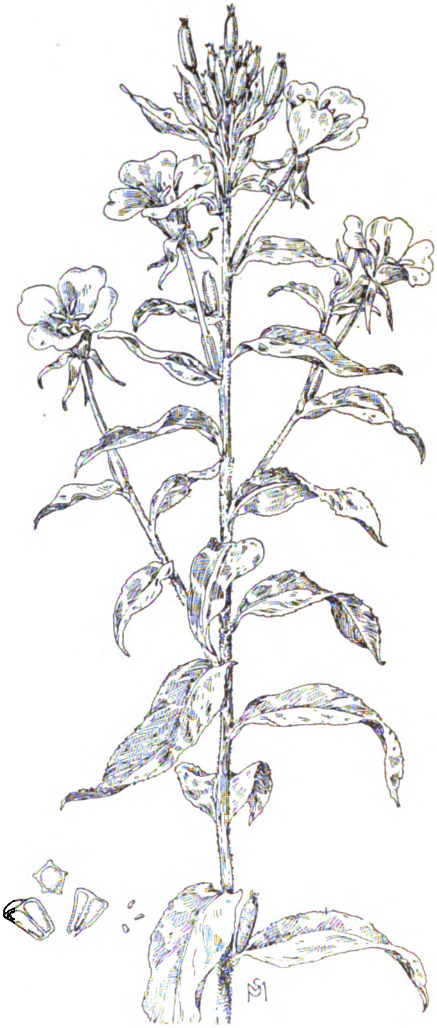
VIOLET FAMILY. VIOLACEAE.

Herbs or shrubs, of which most violets are usually easily recognized; mostly ornamental and harmless. Pansies are in cultivation for their unique flowers.

About 300 species of wide distribution.

Fig. 151.

Wild Pansy. *Viola arvensis* Murr. A slender, erect, biennial, 20-30 cm. high; petals pale yellow; small; capsule, like most violets, when mature splitting into three pieces, each with seeds attached along the middle, the seeds gradually shot in every direction, some of them to a distance of ten feet on level ground. This habit makes it very difficult to keep within bounds when cultivated in a botanic garden, where it becomes quite a pest. Possibly others may find it troublesome.



EVENING PRIMROSE FAMILY. ONAGRACEAE.

This small family of herbaceous plants contains about 350 species of little prominence in an economic way. In Michigan there are a few bee plants and some herbs.

Fig. 152 (135).

Evening-Primrose. *Oenothera. biennis* L. A rather stout, erect, biennial, 30-150 cm. high; leaves narrow, dentate; corolla yellow, opening only in the evening. Open places, common, native of this country.

PARSLEY FAMILY. UMBELLIFERAE.

This rather large family of herbs containing about 1,600 species includes a considerable number that are poisonous when eaten. Here belong parsnips, carrots, dill, caraway, parsley, poison hemlock, sweet cicely, fennel and coriander. Mostly natives of cool regions; species difficult to identify.

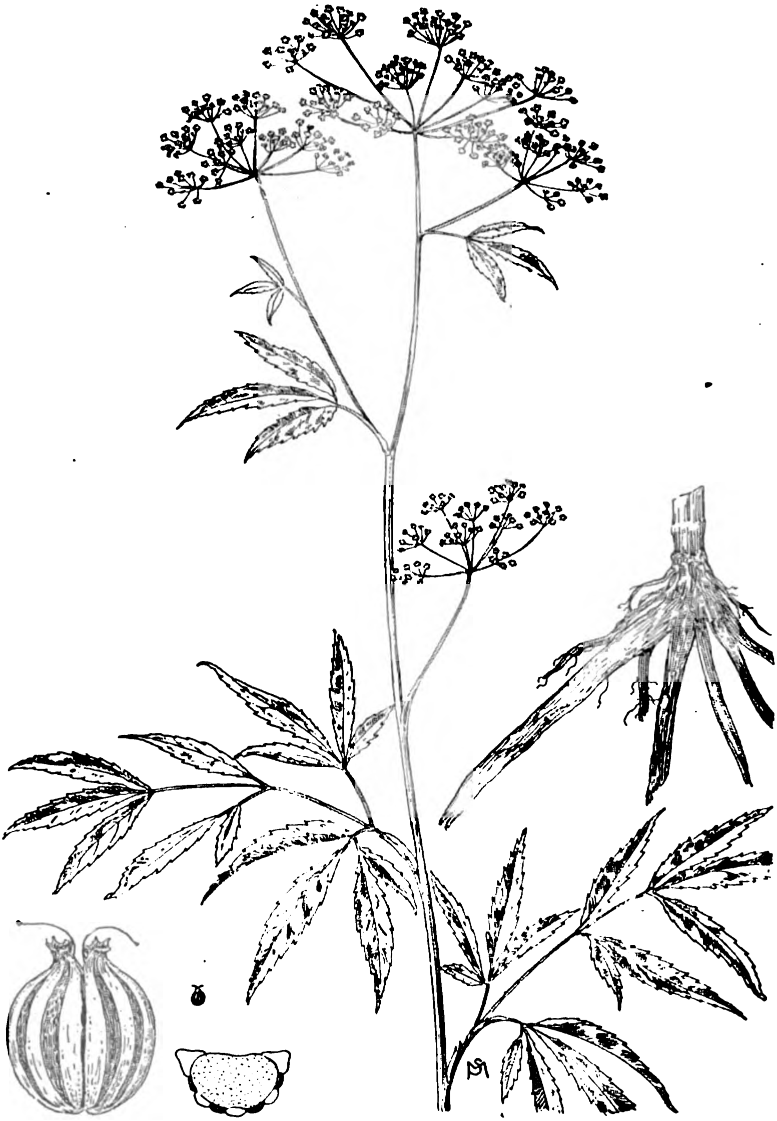


Fig. 153 (136).

Beaver Poison. Water Hemlock. Musquash Root. *Cicuta maculata* L. A rather slender, stiff, open-topped perennial, 1-2.2 m. high, having fleshy roots; leaves compound, the segments serrate; flowers white, fruit borne in compound umbels. A native; abundant on low, moist land. Very poisonous.

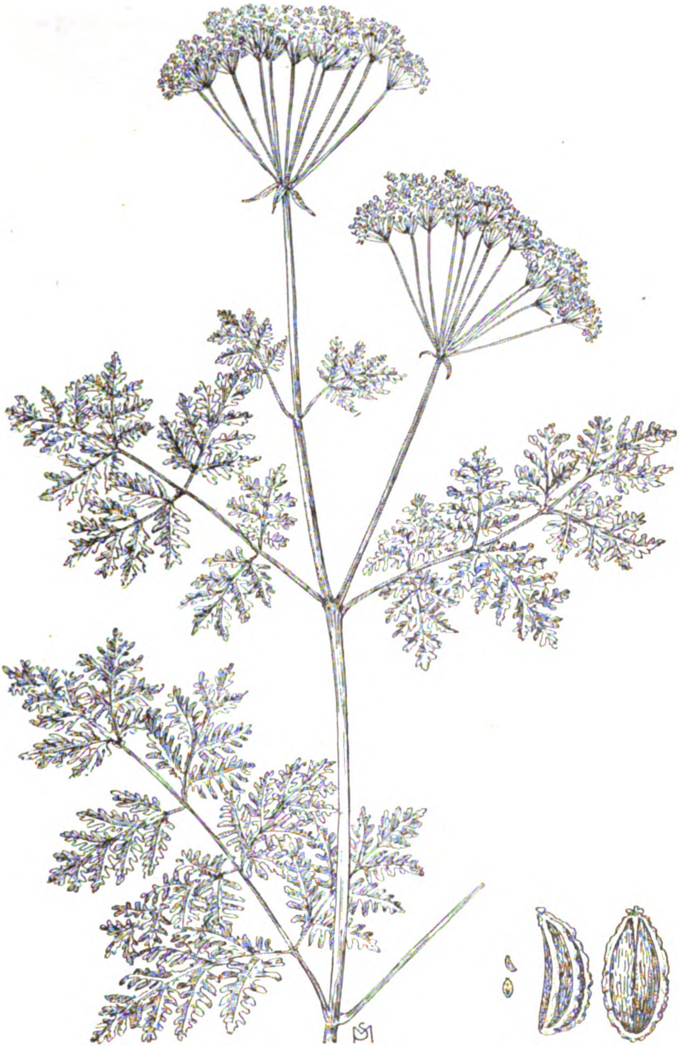


Fig. 154 (137).

Poison Hemlock. Spotted Cowbane. *Conium maculatum* L. An erect, much-branched biennial, stems spotted, 60-150 cm. high; leaves well dissected; flowers white; umbels compound. For details consult some manual of botany. Criminals and philosophers were not unfrequently put to death at ancient Athens by this plant. Introduced from Europe.

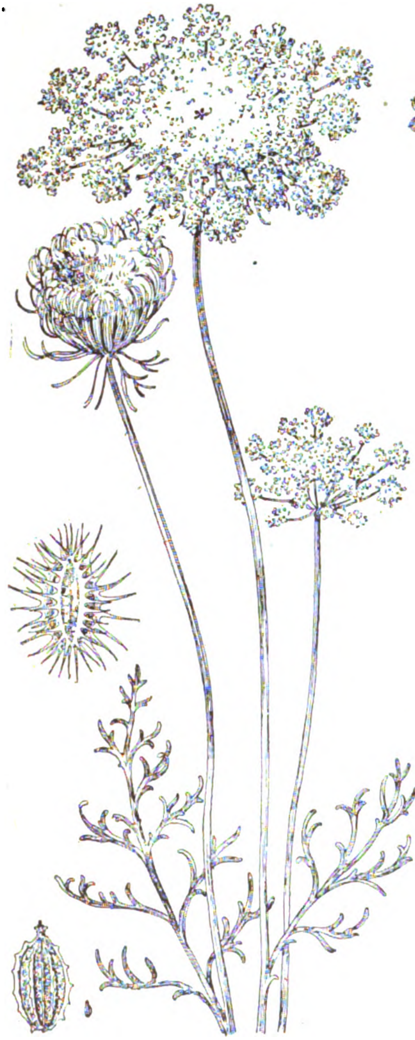


Fig. 155 (138).

Wild Carrot. *Daucus Carota* L. An erect, rough, bushy biennial, 30-90 cm. high; root more or less fleshy; leaves variously lobed and dissected; flowers white, umbels compound; each half fruit bearing four vertical rows of stiff bristles to aid in dissemination. These bristles rub off when passing through a clover huller. When ripe, the rays of the umbel curve toward each other reminding one of a bird's nest. One of our very worst weeds, widely disseminated and rapidly spreading in old pastures and roadsides. Introduced from Europe. Wild carrot is simply the cultivated carrot escaped from cultivation.

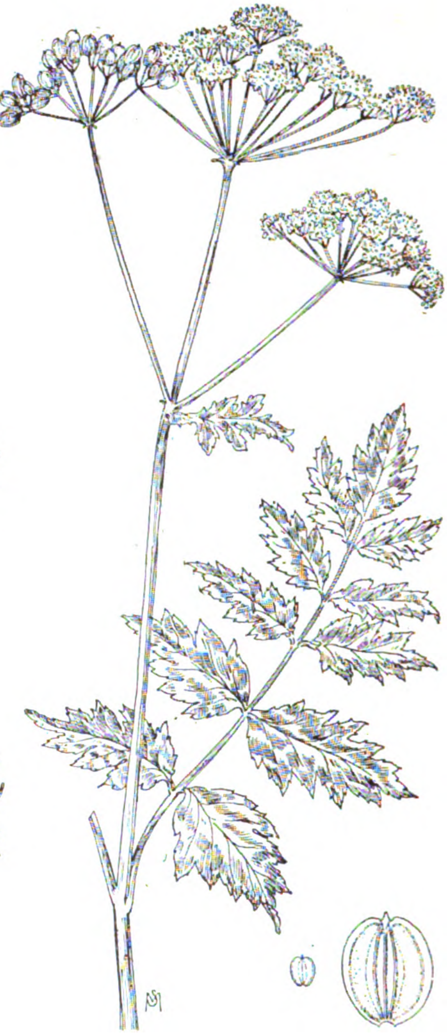


Fig. 156 (139).

Wild Parsnip. *Pastinaca sativa* L. A rather stout, smooth, biennial, 60-150 cm. high, stem grooved, leaves pinnate; flowers yellow; umbels compound; fruit flat, broadly oval.

PRIMROSE FAMILY. PRIMULACEAE.

Plants herbaceous, stamens opposite the lobes of the corolla; ovary with one loculus; placenta free central. The family contains primroses, loosestrife, money-wort, pimpernel, American cowslip.

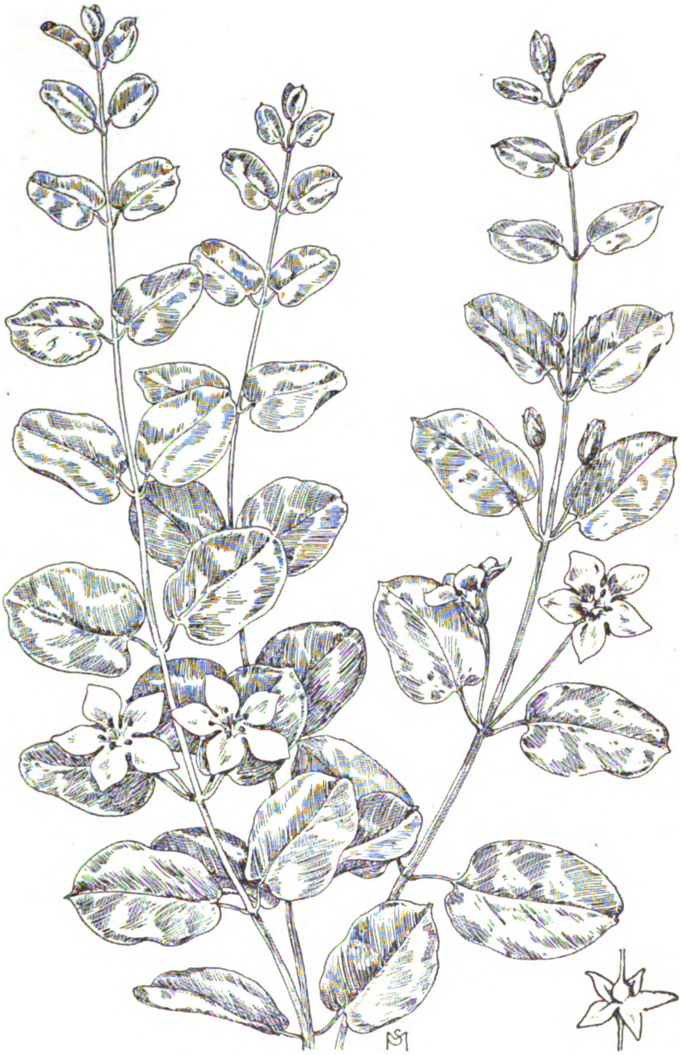


Fig. 157.

Moneywort. *Lysimachia Nummularia* L. A trailing vine with opposite roundish leaves and yellow flowers. A rather pretty plant; escaped from cultivation; introduced from Europe. In some regions a great pest in thin lawns.

DOGBANE FAMILY. APOCYNACEAE.

This family of over 1,000 species mostly found in tropical regions contains herbs, shrubs and trees; ours all herbs, usually abounding in an acrid, milky juice. Botanically nearly allied to the common milk-weeds.

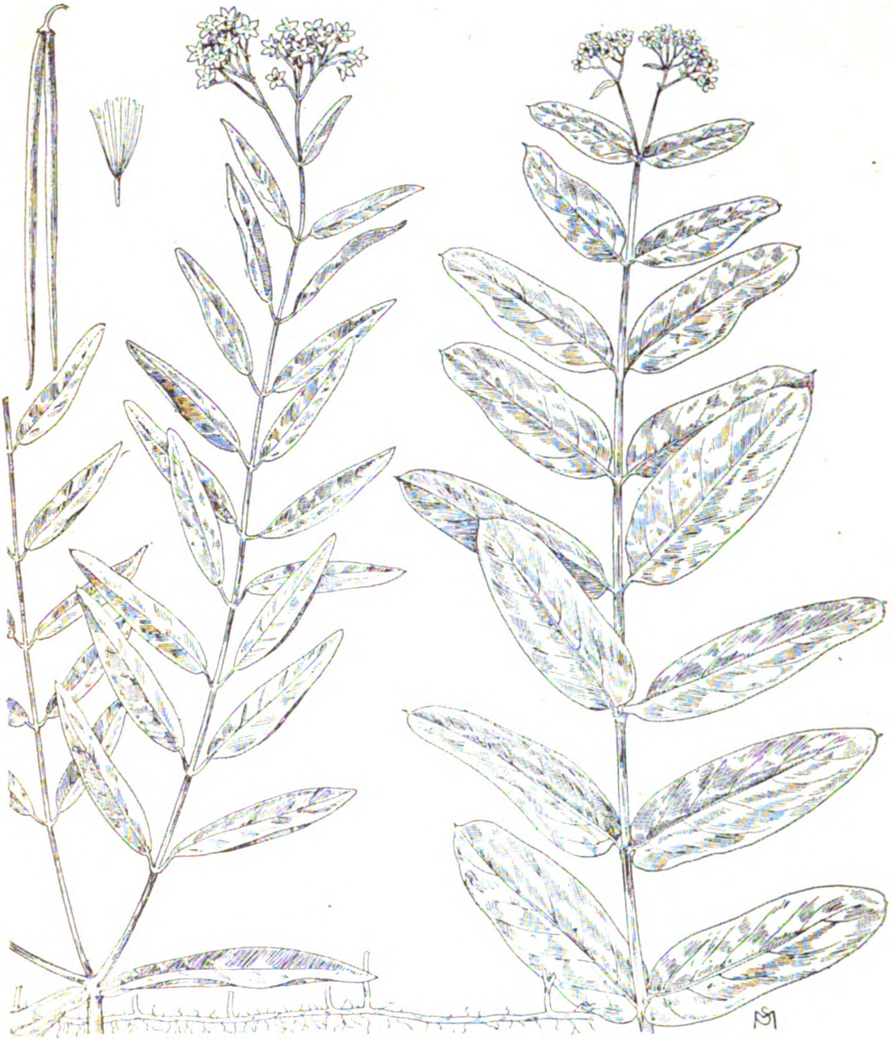


Fig. 158.

Indian Hemp. *Apocynum cannabinum* **L** **Usually smooth, erect, branching, perennial, 20-240 cm. high, coming from vigorous widely extending rootstalks; bark very tough; flowers small, white; leaves narrow, pods in pairs, terete, about 10 cm. long. A native growing on damp, rich soil, on thin soil smaller and less erect.**

Fig. 159.

Apocynum cannabinum hypericifolium **(Ait.) A. Gray. Not so tall, leaves broad at the base, abruptly pointed at the apex.**

MILKWEED FAMILY. ASCLEPIADACEAE.

Perennial herbs or shrubs, mostly having milky juice; flowers too peculiar for beginners, mostly born in umbels; pod one-celled, bearing flat seeds with silky hairs at one end.

A large family, containing 1,900 species mostly found in tropical or warm temperate regions.

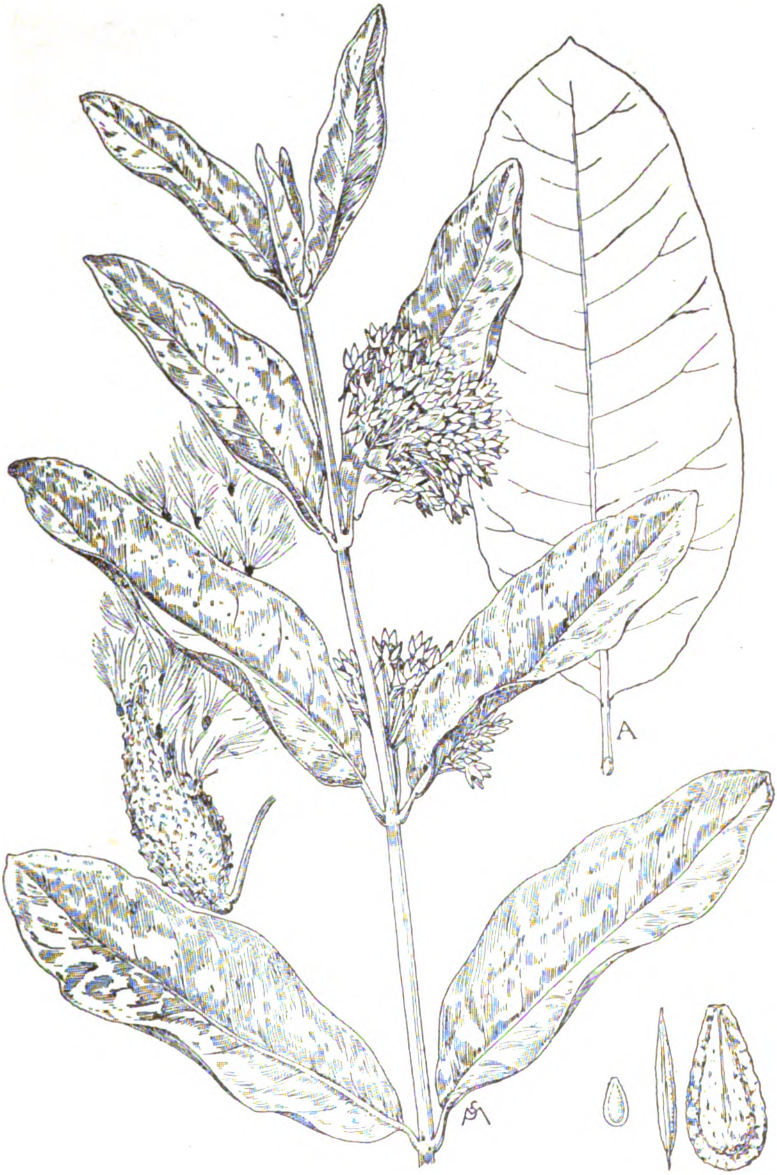


Fig. 160 (140).

Common Milkweed. *Asclepias Syriaca* L. Stem stout, usually unbranched, finely pubescent, coming from deep, fleshy roots difficult of extermination; leaves opposite, broad, flowers in umbels; pods 8-13 cm. long, covered with soft spinous processes.

A native plant very troublesome on sandy land in the northern part of the state where the crop is undisturbed for more than two years. Occasionally "sick" with a pale, dwarf growth, a bacterial disease.

MORNING GLORY FAMILY. CONVOLVULACEAE.

Chiefly twining vines, often containing milky juice; a few cultivated for ornament, and one, the sweet potato, for its edible roots; a number are leafless parasitic vines.

A rather large family including 900 species, mostly native to the tropics.

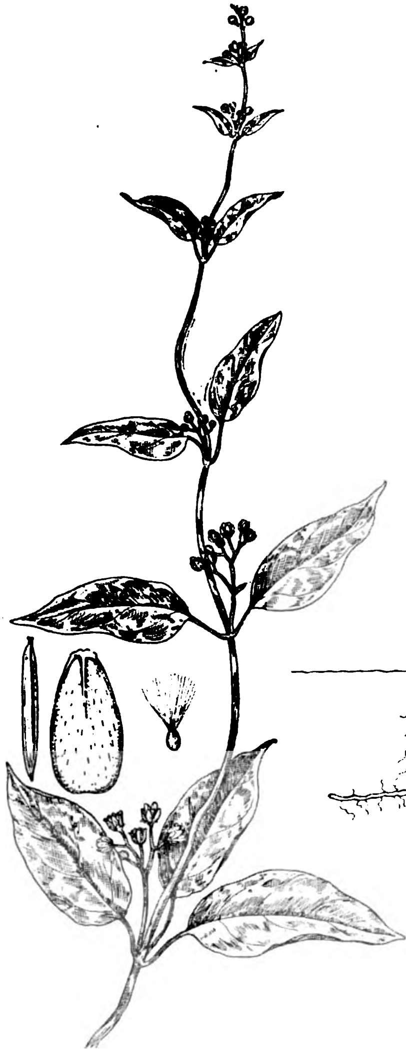


Fig. 161 (141).

Black Swallow-wort. *Cynanchum nigrum* (L.) Pers. (*Vincetoxicum nigrum* Moench.) A rather neat, smooth, dark green perennial twining vine; 60-150 long; leaves narrow; flowers small, dark purple; pods about 5 cm. long.

Introduced from Europe and a pest in land not cultivated.

(Fig. 161 belongs to the Milkweed family.)

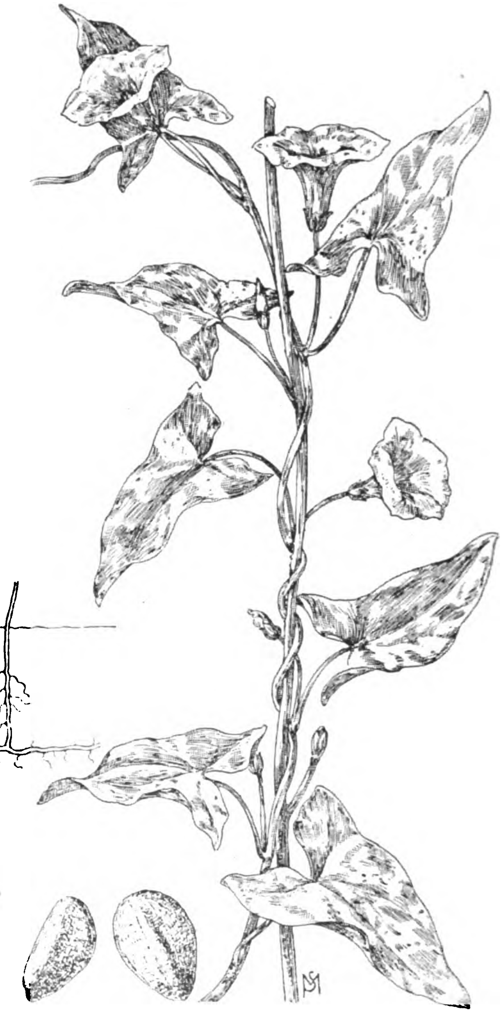


Fig. 162 (142).

Small Bindweed. *Convolvulus arvensis* L. A smooth, slender, prostrate or twining vine from deep, widely spreading, perennial, fleshy roots; leaves arrow or halberd shaped, 2-3 cm. long; flowers bell shaped, seldom abundant, white or tinged with pink, 1.5-2 cm. long.

A very persistent weed when growing in sandy land. Introduced from Europe.

Other names sometimes used; Hedge-bells, Bearbind, Bellbine, Corn-bind, Lap-love, Sheepbine.

Very troublesome in sand or gravel.

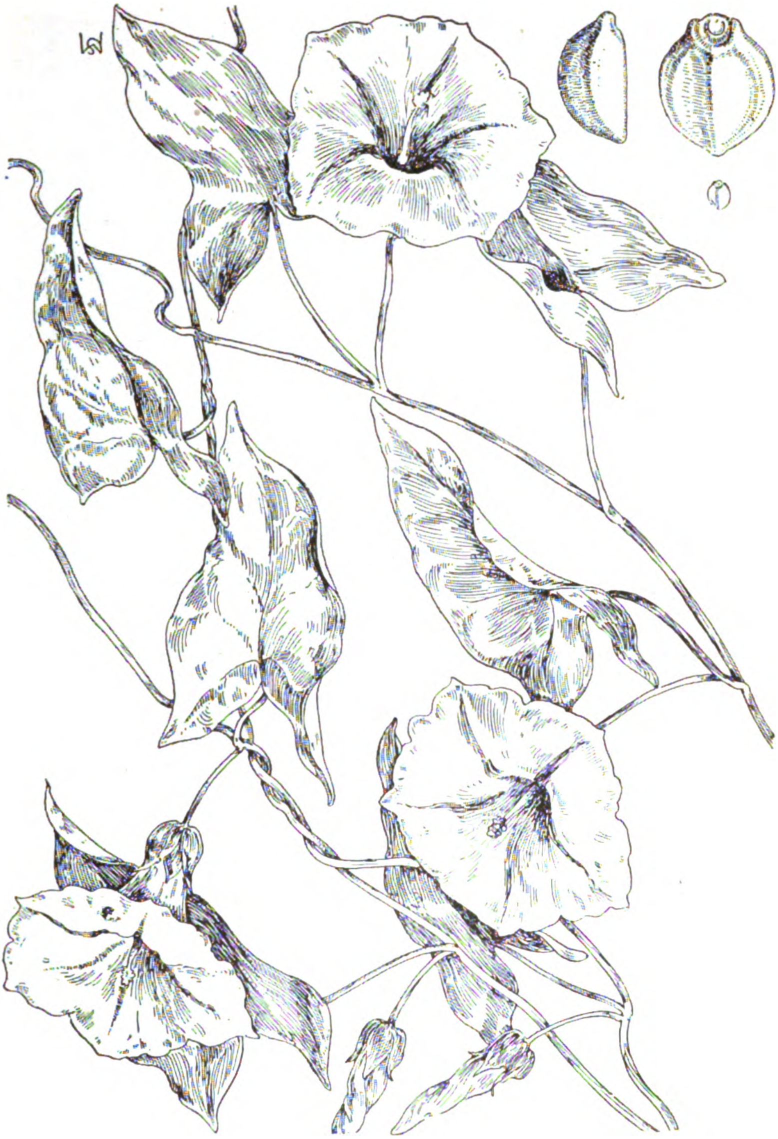


Fig. 163 (143).

Hedge Bindweed. Great Bindweed. *Convolvulus sepium* L. A long, trailing or climbing herbaceous vine from a perennial fleshy root, usually smooth; leaves petiolate, blades triangular in outline, halberd-shaped, acute; corolla, bell-shaped, white or tinged with pink, 3-5 cm. long. A native plant seldom producing seeds. Moist soil.

Other names used, Bell-bind, Wood-bind, Lady's Night-cap, Hedge Lily.

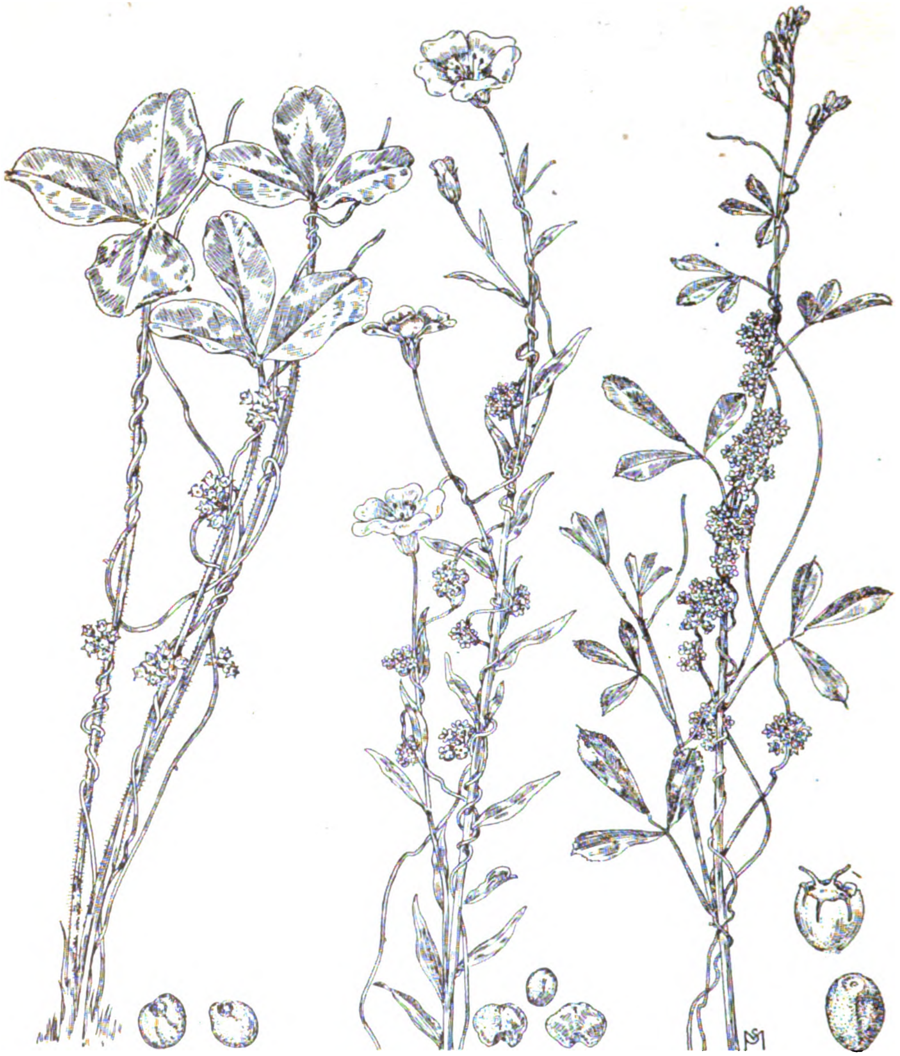


Fig. 164. Fig. 165. Fig. 166.

Fig. 164 (144). **Field Dodder.** *Cuscuta arvensis* Beyrich. A pale yellow, slender, leafless, parasitic vine, branching and spreading and more or less exhausting plants of red clover or alfalfa and some other herbs. Flowers small, white, 1.5-2 mm. long.

Fig. 165 (145). **Flax Dodder.** *Cuscuta Epilinum* Weihe. A very slender, pale yellow or red, leafless parasitic vine, branching and spreading and exhausting plants of flax; flowers small, yellowish. Introduced from Europe and troubling flax.

Fig. 166 (146). **Lesser Clover Dodder. Thyme Dodder.** *Cuscuta Epithymum* Murr. An extremely slender, red, leafless, parasitic vine, branching freely and spreading and more or less exhausting plants of red clover, thyme, and a few other plants; flowers white or pinkish. Under favorable conditions living near the ground on low plants all winter. Introduced from Europe.

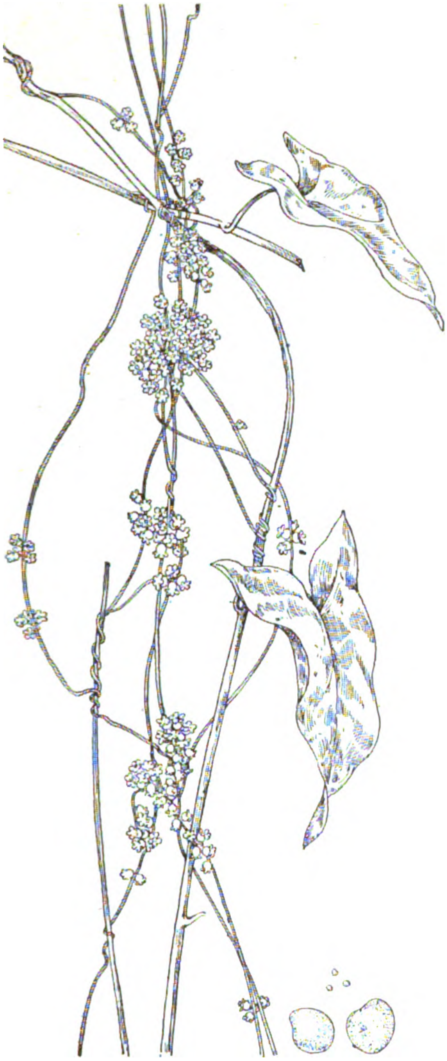


Fig. 167 (147).

Gronovius' Dodder. *Cuscuta Gronovii* Willd. A yellow-orange, leafless, parasitic vine, branching and spreading freely and becoming attached to a great variety of plants, wild balsam, young twigs of willow, nettles, etc.; flowers white. Native to low or moist land.

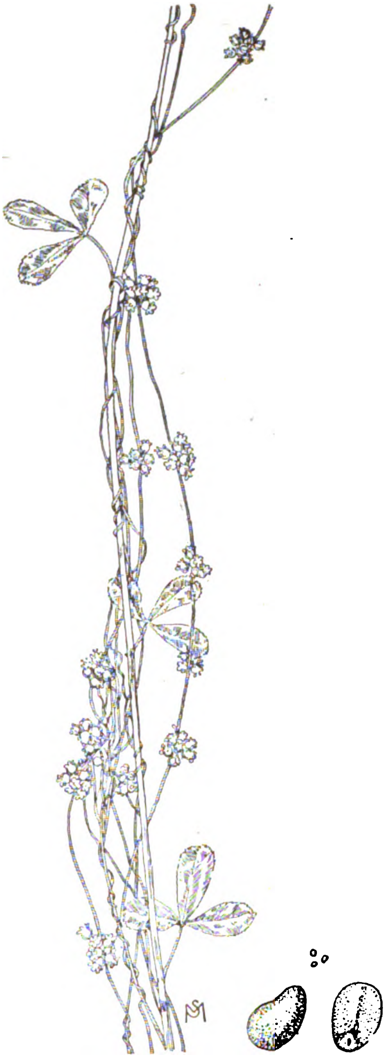


Fig. 168 (148).

Spanish Dodder. *Cuscuta planiflora* Tenore. A slender, leafless, parasitic vine, branching and spreading over plants of red clover.

Dodder. *Cuscuta.* Other species may be introduced, but their growth and behavior will be much the same as that of the above species.

BORAGE FAMILY. BORAGINACEAE.

Chiefly rough hairy herbs; flowers usually blue or white in one-sided cymes, mostly coiled from the apex when young, and straightening as the successive flowers expand. A rather large family of mucilaginous plants, consisting of 1,500 species.

Here belong heliotrope, mertensia, forget-me-not, gromwell, comfrey, borage, and several weeds.

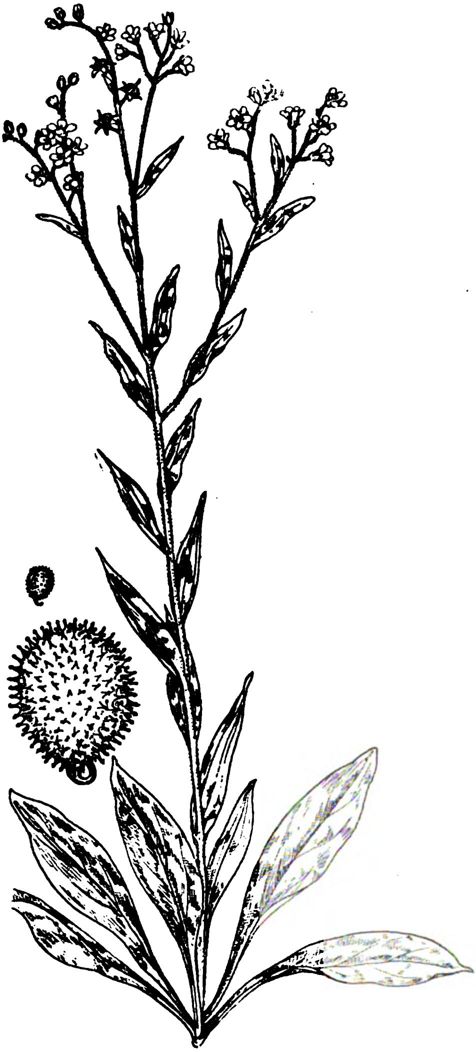


Fig. 169 (149).

Hound's Tongue. *Cynoglossum officinale* L. A stout, coarse, erect, biennial, 40-120 cm. high; corolla reddish-purple; nutlets flat, oblique, roughened with short barbed, hooked prickles, making a sharp bur.

Introduced from Europe into waste places and old pastures.

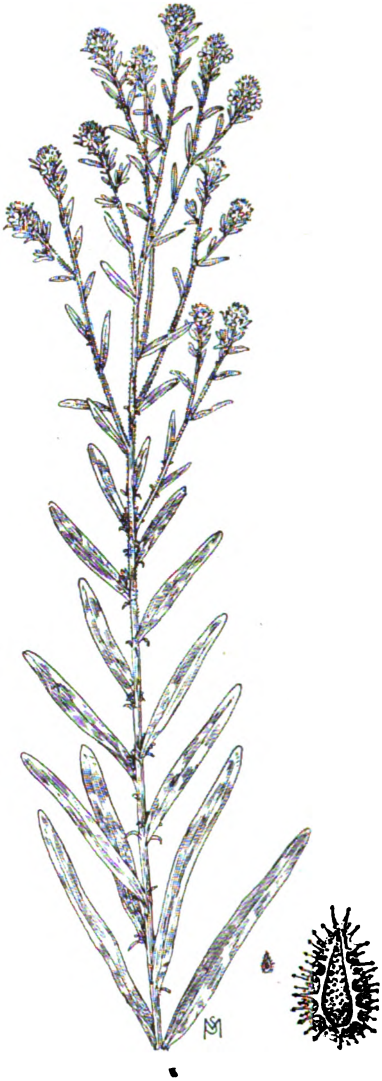


Fig. 170 (150).

Stick-seed. Bur Seed. *Lappula echinata* Gilbert. (*Echinospermum Lappula* Lehmn.) An erect, rough, annual, 30-60 cm. high; corolla blue. Naturalized from Europe.

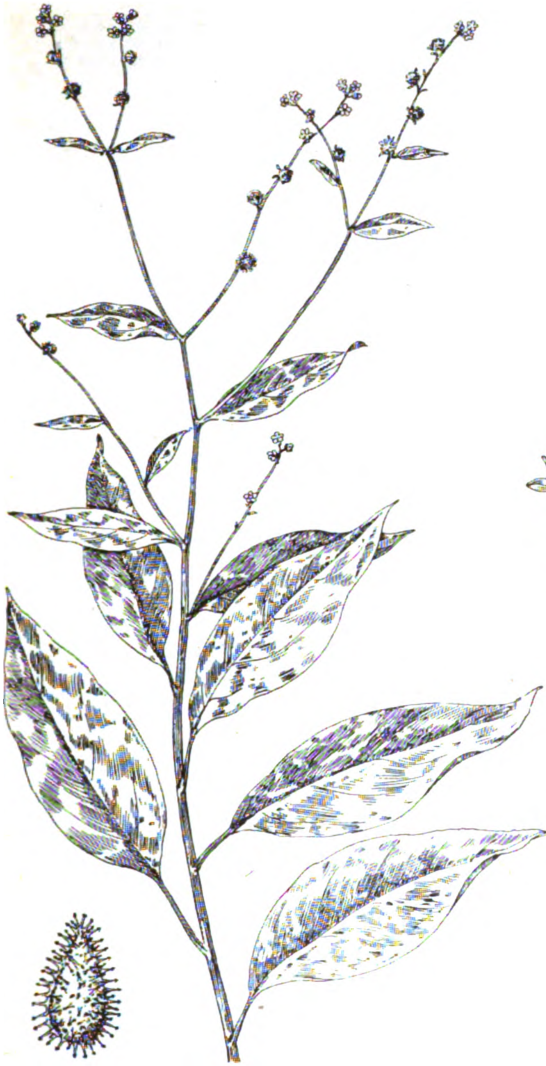


Fig. 171 (151).

Beggar's Lice. *Lappula Virginiana* (L.) Greene. A pubescent, branching biennial, 60-120 cm. high; lower leaves with petioles, blades, round-ovate; upper leaves ovate-oblong, acuminate at both ends; racemes very slender, fruit ovoid. A native of rich woods.

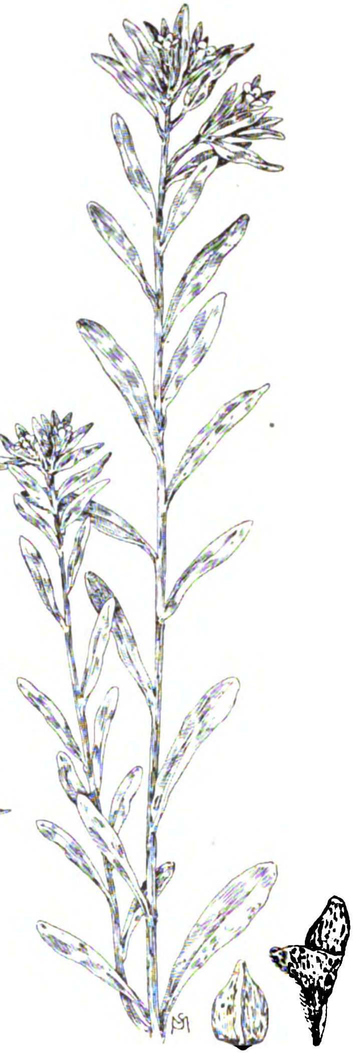


Fig. 172 (152).

Red Root. Wheat Thief. Corn Gromwell. *Lithospermum arvense* L. A minutely roughened and hoary biennial, stems spreading, 20-70 cm. high; leaves narrow; flowers small, white, sessile. Especially a wheat weed, as it needs to grow the same as winter wheat in the fall, maturing the next summer. The size of the nutlets makes it somewhat difficult to screen from wheat. Introduced from Europe.

VERVAIN FAMILY. VERBENACEAE.

This family of 1,200 species widely distributed in temperate and warm regions is not prominent in Michigan. It includes species of Verbena and Lantana cultivated for ornament and two or three native weeds of little prominence. It is in great contrast with the rose family of the same size, which affords so many prominent fruits and the queen of flowers, the rose.

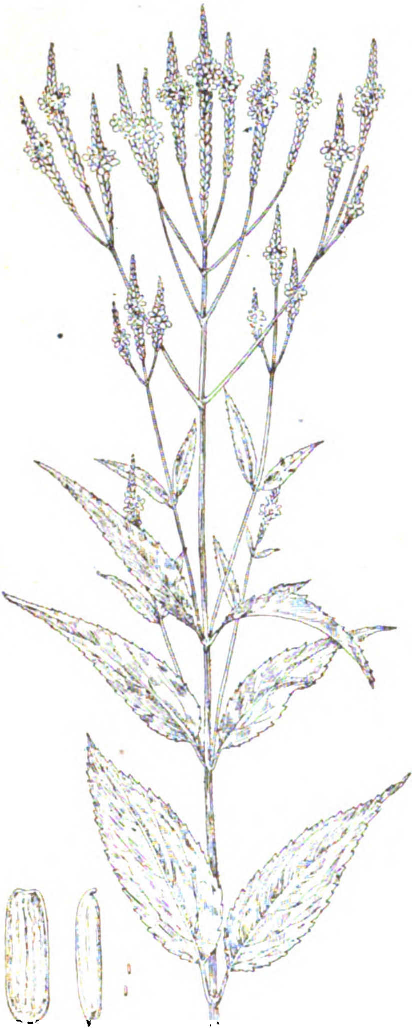


Fig. 173 (153).

Blue Vervain. *Verbena hastata* L. An erect, roughish perennial, 30-200 cm. high; leaves rather narrow, taper-pointed; spikes of flowers narrow, erect; flowers violet-blue. At home in low mucky ground. A native plant.

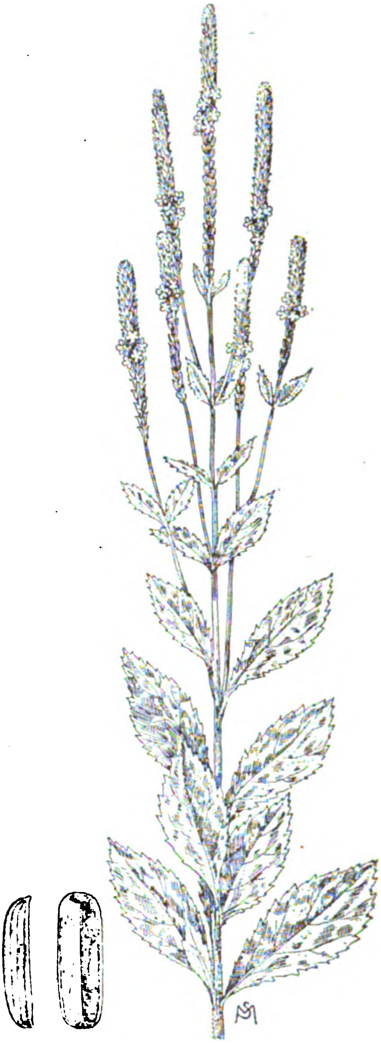


Fig. 174.

Hoary Vervain. *Verbena stricta* Vent. An erect, downy perennial, 30-90 cm. high; stem four-sided; leaves sessile, obovate or oblong, serrate; spikes thick; flowers purple.

A weed in the prairie regions of the state; introduced from the west.

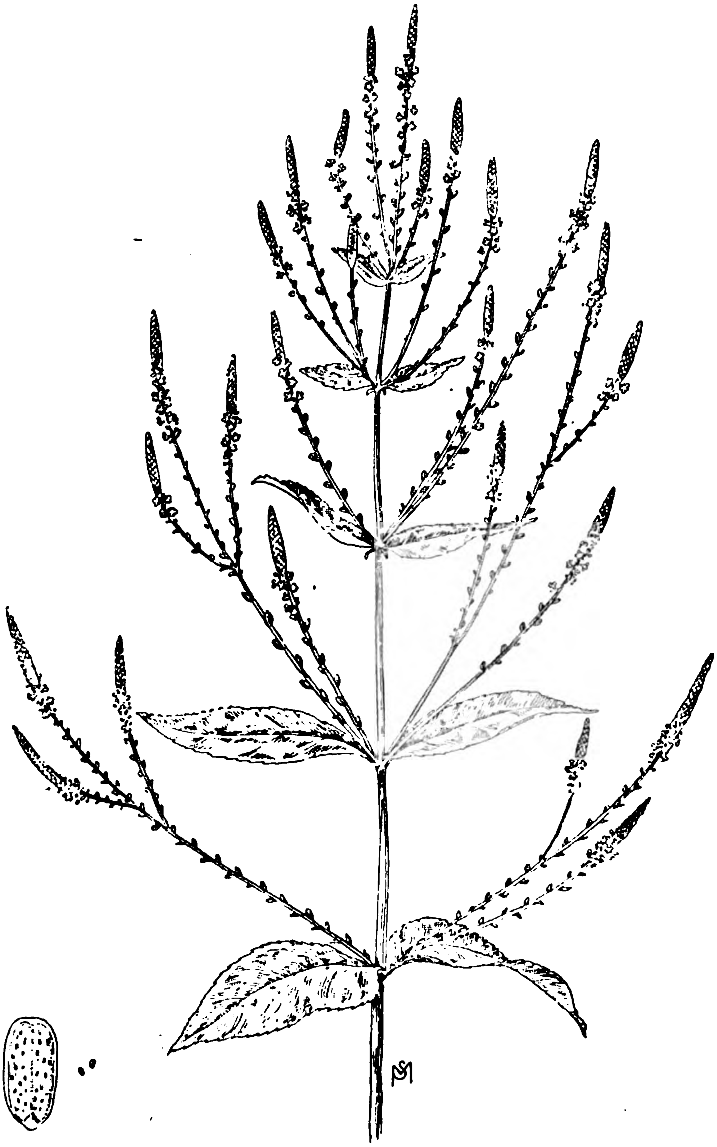


Fig. 175 (154).

Nettle-leaved Vervain. *Verbena urticaefolia* L. Perennial, usually pubescent, stem erect, four-sided; 90-150 cm. high; leaves ovate, or oblong-ovate, coarsely serrate; spikes narrow, interrupted, becoming, 10-15 cm. long; flowers very small, white. Native to low land, hybridizing with *Verbena hastata*, *V. bracteosa*, *V. stricta*.

MINT FAMILY. LABIATAE.

A large family of 3,000 species of aromatic herbs or shrubs, having square stems and opposite leaves; flowers irregular, mostly two-lipped; abounding in temperate and tropical regions. Here belong pennyroyal, germander, skullcap, self-heal, dragon heal, sage, motherwort, horehound, peppermint, catnip, hyssop, marjorum, thyme, stone-root, and many more, often known as sweet herbs. There are some grown for the beauty of their flowers or foliage, a few are weeds, but none are grown in Michigan for fruits, vegetables or forage.

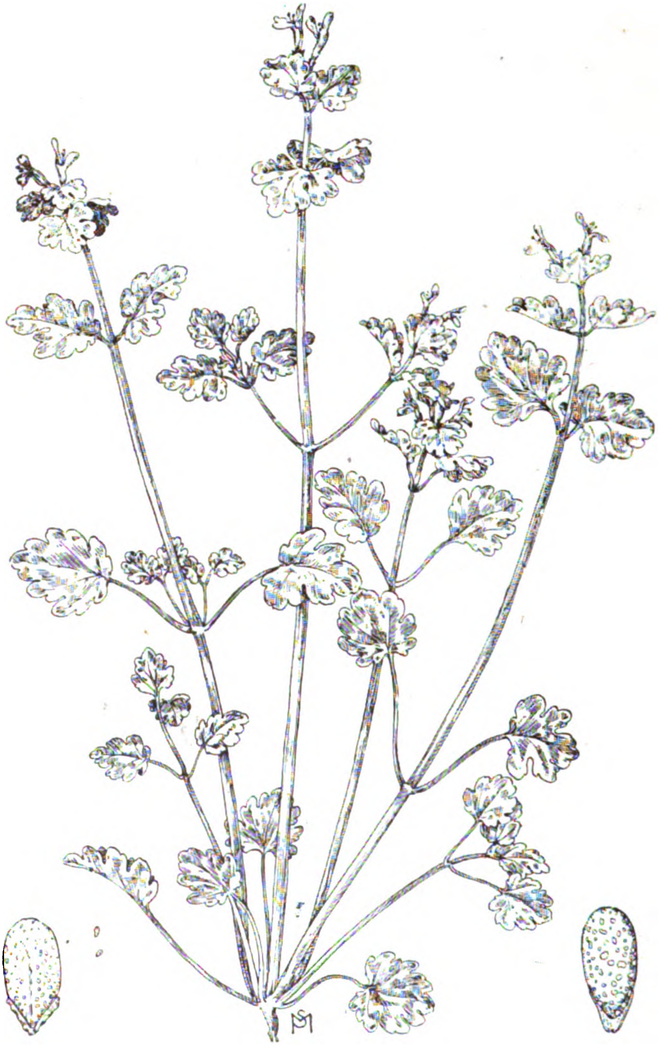


Fig. 176 (155).

Dead Nettle. Henbit. *Lamium amplexicaule* L. Annual or biennial, slightly pubescent; stems slender, weak, spreading, 15-30 cm. high; leaves nearly circular in outline, deeply lobed or toothed; flowers in clusters, corolla, red or purplish.

Introduced from Europe and a bad weed in cool weather, dying in hot weather.

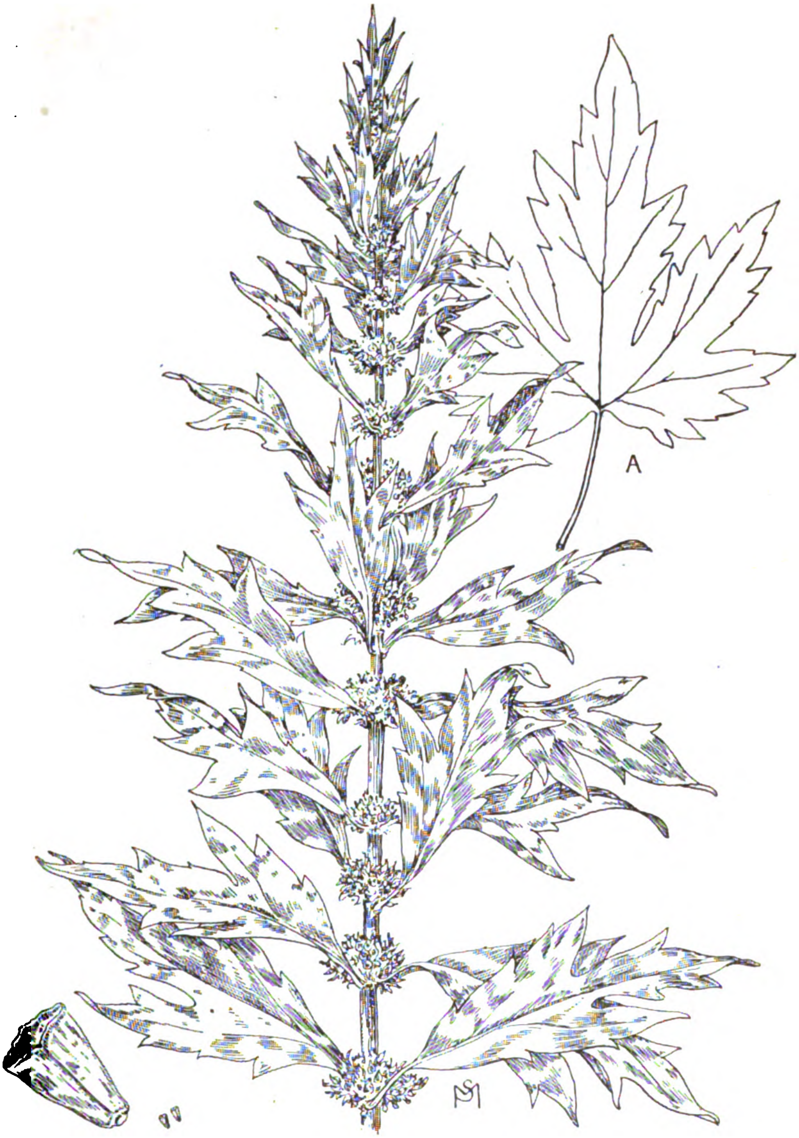


Fig. 177 (156).

Motherwort. *Leonurus Cardiaca* L. A rather stout, erect perennial, 60-120 cm. high; leaves with long stems, the blades broad, 3-5 cleft; corolla pink or purple.
In waste places, introduced from Europe.

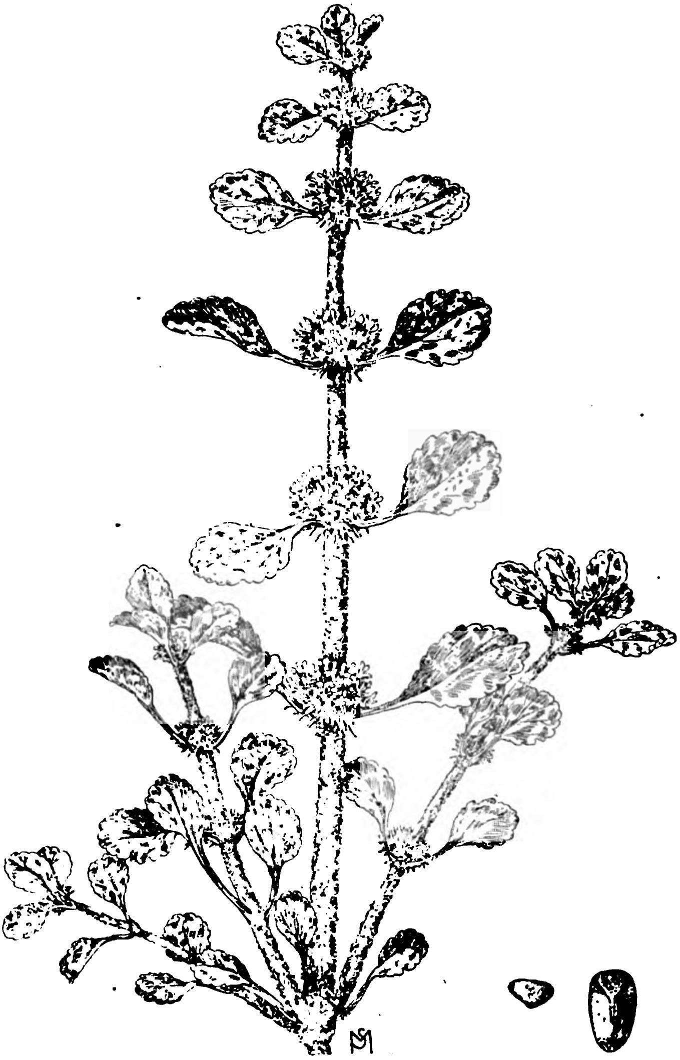


Fig. 178 (157).

Hoarhound. *Marrubium vulgare* L. A bitter, whitish-woolly perennial, 30-90 cm. high; leaves veined, circular to oval; densely many-flowered, corolla small, white. Introduced from Europe, and thrives in waste places where plants are protected all winter by snow.

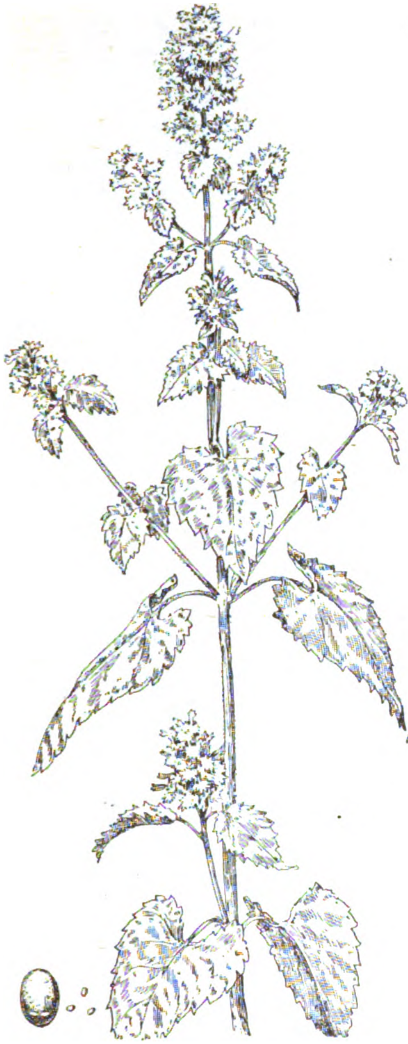


Fig. 179 (158).

Catnip. Catmint. *Nepeta Cataria* L. A downy, erect, pale green perennial, 60-90 cm. high; leaves heart-shaped, oblong, deeply notched; corolla whitish, dotted with purple.

A rather shy weed making little or no trouble. Introduced from Europe.

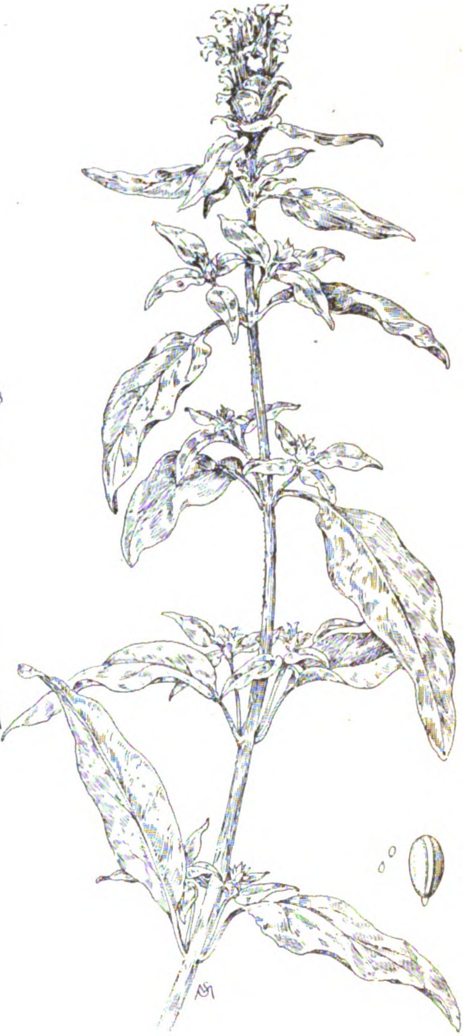


Fig. 180 (159).

Self-heal. Heal-all. Blue-curls. *Prunella vulgaris* L. Hairy or smooth, perennial, often procumbent, 15-40 cm. high; leaves ovate-oblong, entire or toothed; corolla violet, purple or white. Waste places, especially in thin lawns, old meadows and pastures.

Introduced from Europe.

POTATO FAMILY. NIGHTSHADE FAMILY. SOLANACEAE.

Herbs or shrubs, foliage rank scented, fruit ranging from very poisonous to edible berries; prominent in the tropics, about 1,600 of them. Here are found the potato, tomato, ground cherry, tobacco, petunia, Jimson weed, henbane, matrimony vine, bittersweet, horse nettle, buffalo bur, apple-of-Peru.

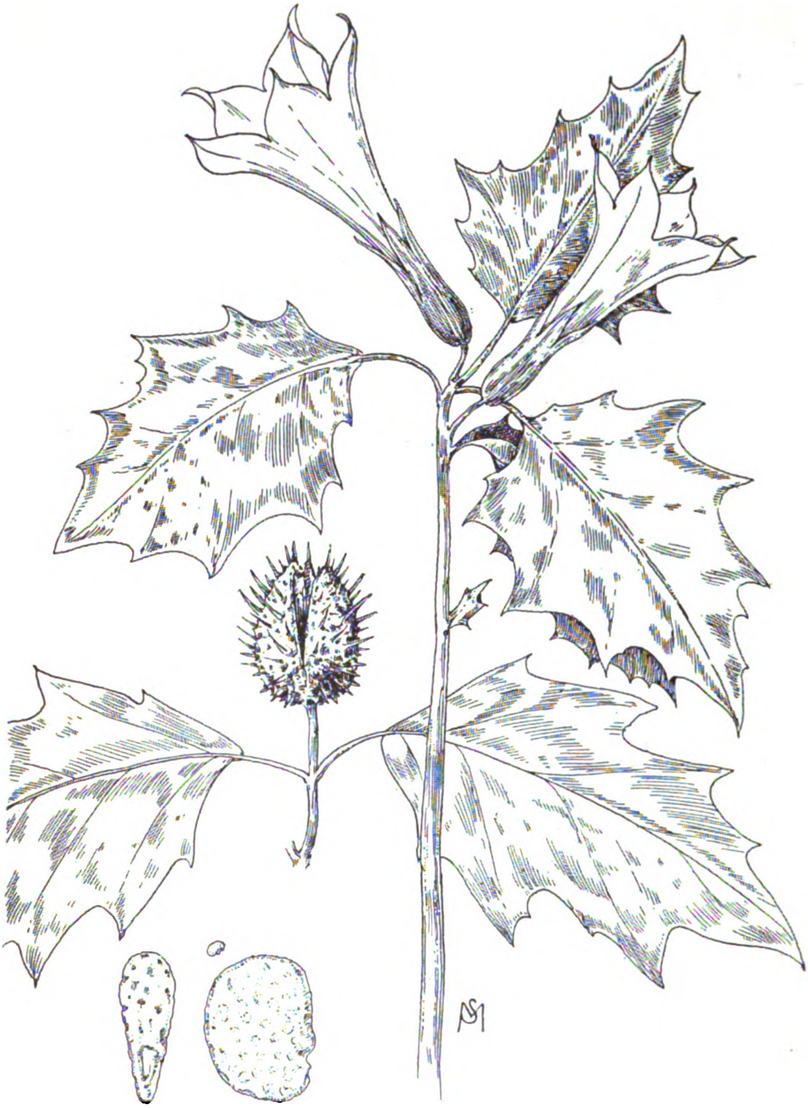


Fig. 181 (160).

Jimson Weed. Thorn Apple. *Datura Stramonium* L. A coarse, narcotic, poisonous, annual, 30-150 cm. high, stems green; corolla white, funnel form, 7-10 cm. high; capsules ovoid, stiff, prickly, about 5 cm. long.

In waste places; introduced from Europe.

Fig. 182 (161).

Purple Jimson Weed. Purple Thorn Apple. *Datura Tatula* L. A coarse, narcotic, poisonous, annual, 30-150 cm. high, stem purple; corolla pale violet-purple, funnel-form, 7-10 cm. high; capsules ovoid, stiff, prickly; very nearly like *D. stramonium* excepting the stems are purple. (The differences being mainly those of color, the same illustration is made to serve for both).

Naturalized from Europe, waste places.

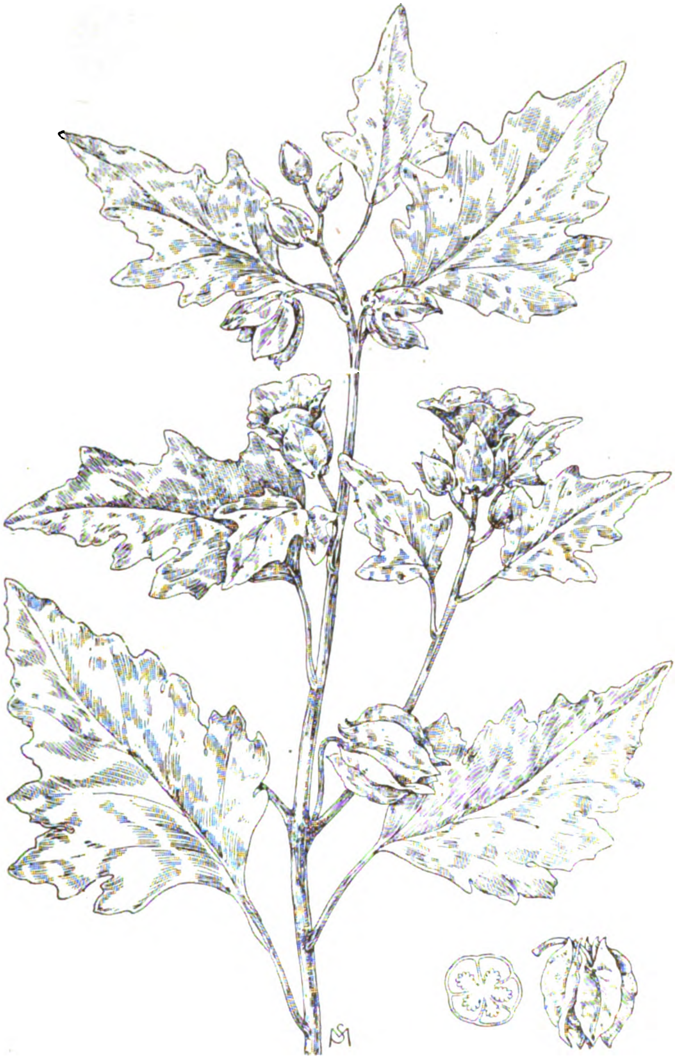


Fig. 183.

Apple-of-Peru. *Nicandra Physalodes* (L.) Pers. (*Physalodes physalodes* (L.) Britton.) An erect, coarse, smooth annual, 60-150 cm. high; stem angled; leaves ovate, toothed, narrowed at the base; calyx enlarged, bladder-like in fruit, enclosing a spherical, dry berry; corolla bell shaped, white with purple spots. Calyx like that of *Physalis*, leaves like those of *Datura*. Waste places, introduced from Peru.

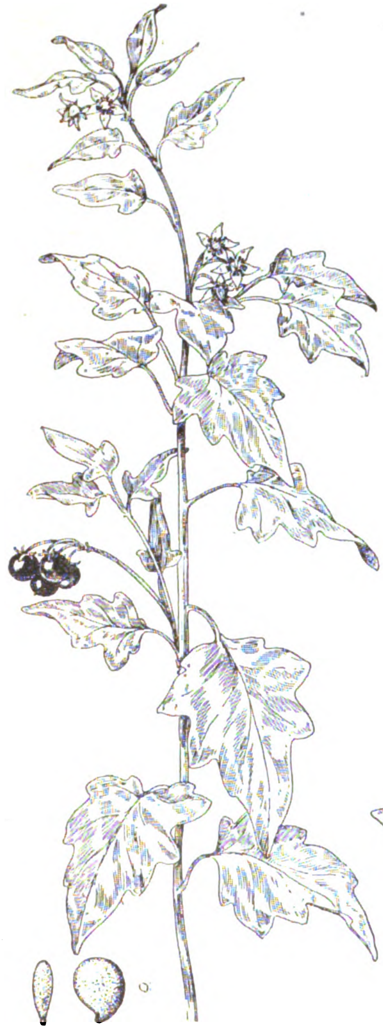


Fig. 184 (163).

Black Nightshade. *Solanum nigrum* L. Usually smooth, branching and spreading, annual, stem rough on the angles, 30-45 cm. high; leaves ovate, wavy-toothed, more or less unequal sided; flowers white; berries spherical, black, appearing as if introduced.

Very extensively distributed as a weed. The berries make good pies; not poisonous when fully ripe.

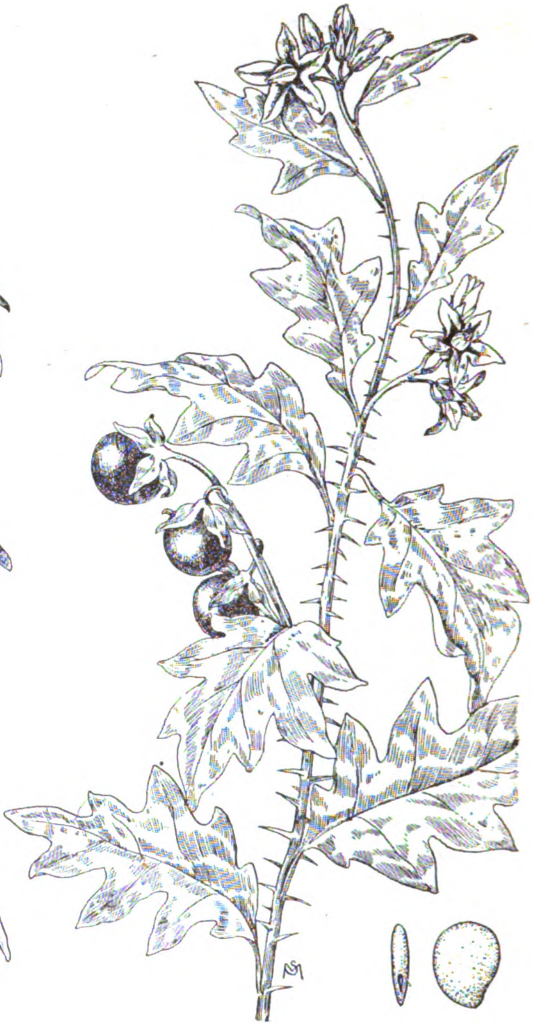


Fig. 185 (162).

Horse Nettle. Apple of Sodom. *Solanum Carolinense* L. Perennial, rough-pubescent with four-eight-pronged hairs, and stout yellow prickles, erect, 30-120 cm. high coming from numerous deep wandering roots; leaves somewhat resembling those of red oak; berry 1-1.5 cm. broad.

Sandy soil and waste grounds, coming from the southwest.

FIGWORT FAMILY. SCROPHULARIACEAE.

A large family of seed plants consisting of 2,500 species most abundant in temperate regions. Its botanical peculiarities on one side shade off into the potato family and on the other into the mint family.

A remarkably small number of plants are distinguished for economic qualities. A few are ornamental, a few are weeds; there is not a "fruit," "vegetable" or forage plant in the list.

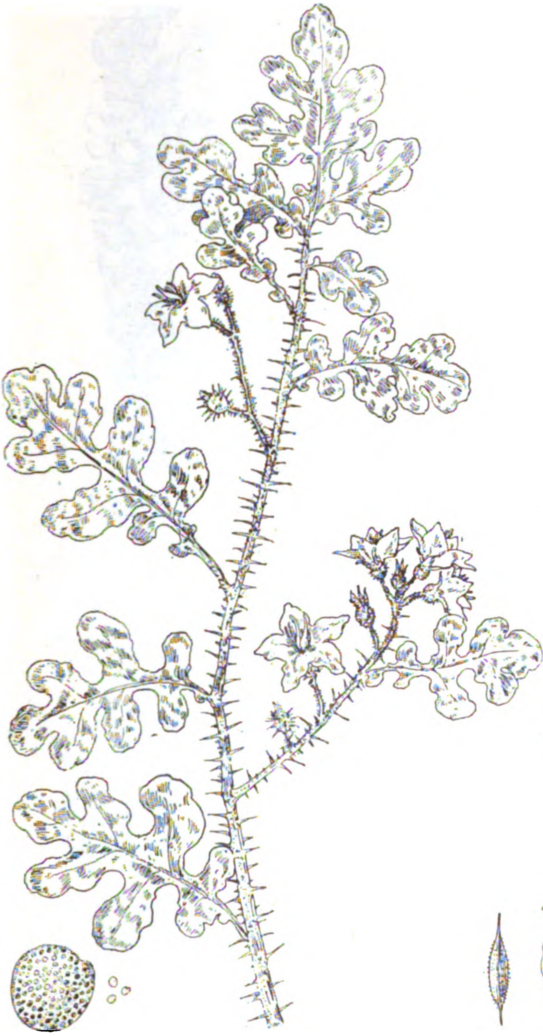


Fig. 186 (164).

Beaked Nightshade. *Solanum rostratum* Dunal. A very prickly, bushy, yellowish, annual, 30-60 cm. high; leaves pinnately-lobed; calyx densely prickly; corolla yellow; fruit a formidable, spiny bur, about 3 cm. in diameter.

Waste places, hailing from the south and west, where it was the original food of the famous potato beetle.

(Fig. 186 belongs to Nightshade family.)

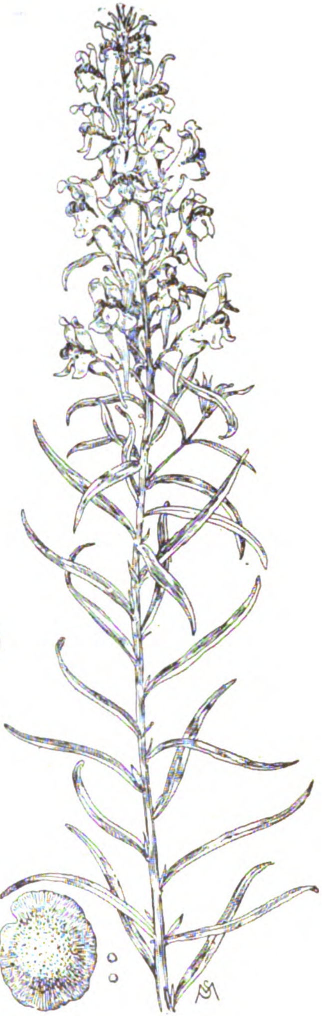


Fig. 187 (165).

Butter and Eggs. Toadflax. *Linaria vulgaris* Hill. (*Linaria Linaria* (L.) Karst.) A pale green, erect perennial, 30-90 cm. high, spreading by slender underground stems; leaves very numerous, very narrow; flowers light yellow and dark orange having a spur at the base.

Naturalized from Europe and widely distributed as a weed in temperate regions.

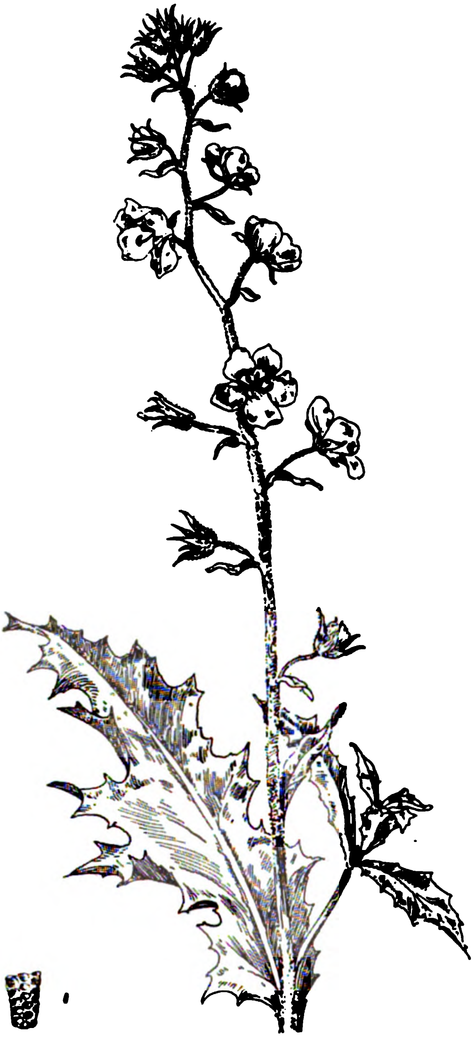


Fig. 188 (166).

Moth Mullein. *Verbascum Blattaria* L. Biennial, stems slender, erect, branching but little, 60-120 cm. high, smooth or sparingly covered with glandular hairs; leaves rather narrow; raceme loose, simple, long; corolla yellow or white.

A bad weed in old grass land or along road sides. Introduced from Europe.

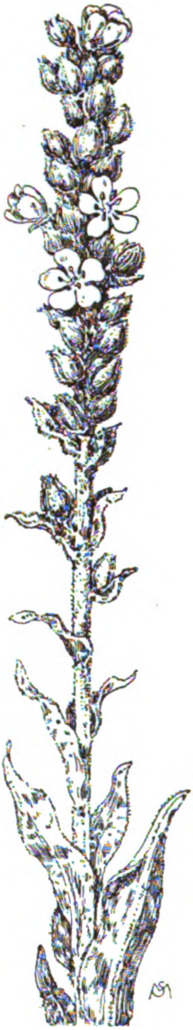


Fig. 189 (166).

Common Mullein. Velvet-leaved Mullein. *Verbascum Thapsus* L. Biennial, densely woolly throughout, stem simple, erect stout, 30-200 cm. high; leaves oblong, extending down the stem (decurrent); flowers yellow in a very long dense spike.

Introduced from Europe and widely dispersed especially on land recently cleared and in old pastures.

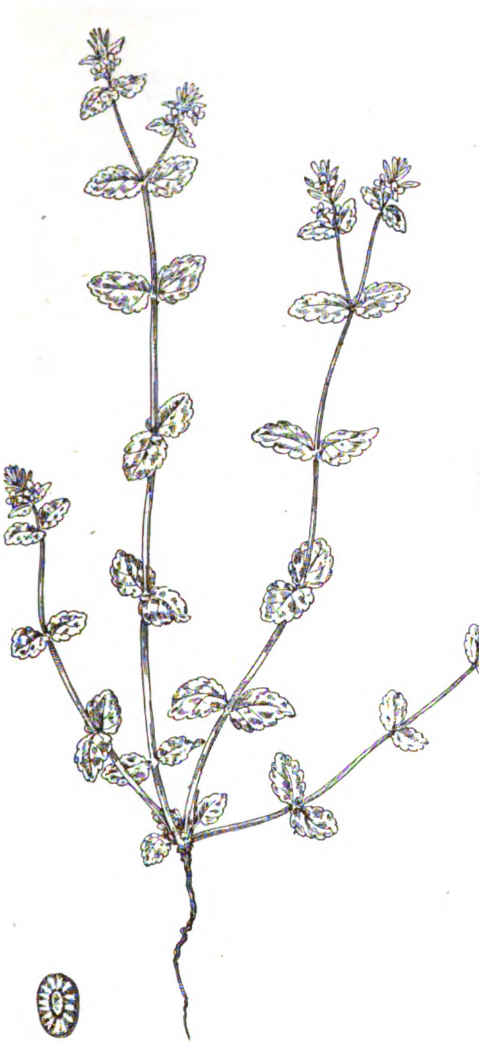


Fig. 190 (167).

Corn Speedwell. Wall Speedwell. *Veronica arvensis* L. Annual, pubescent, simple or branched, 5-40 cm. high; lower leaves petioled, oval, the upper sessile narrow, entire; corolla blue or nearly white.

Cultivated grounds, in old thin grass land Naturalized from Europe.

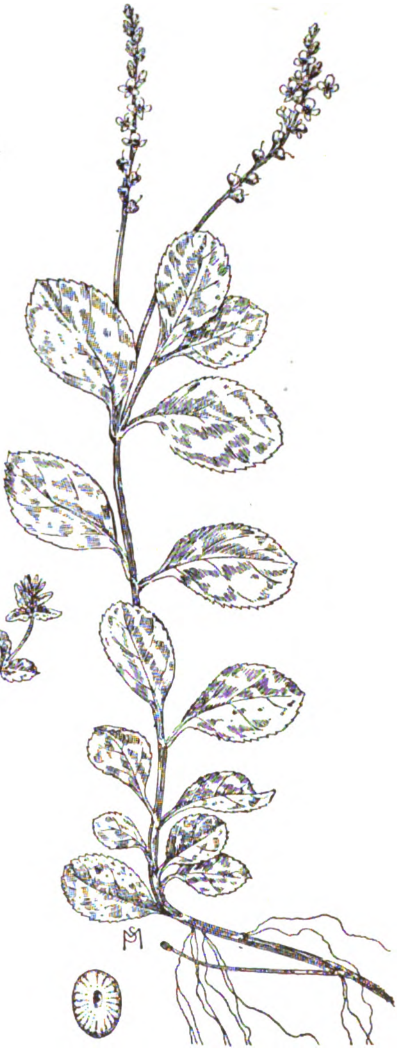


Fig. 191 (168).

Common Speedwell. *Veronica officinalis* L. A prostrate, pubescent perennial, spreading by stems rooting at the joints, 7-25 cm. high; leaves oblong, petioled, serrate; racemes narrow, densely flowered; corolla pale blue.

Dry fields and woods, probably a native plant.

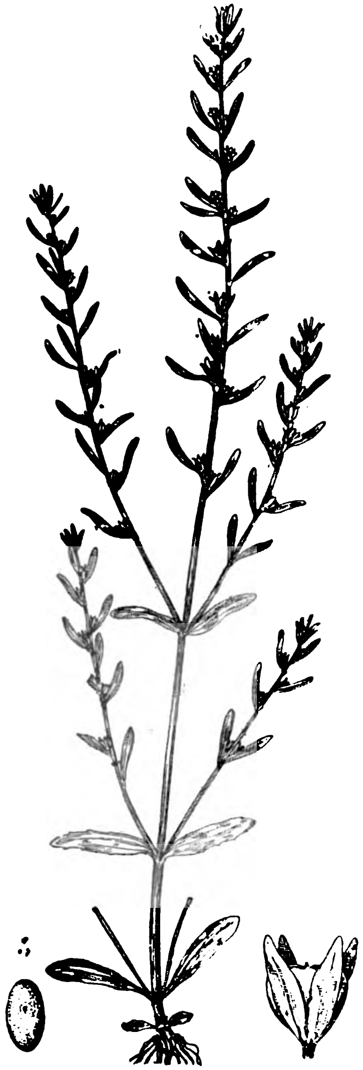


Fig. 192 (169).

Neckweed. Purselane Speedwell. *Veronica peregrina* L. Annual, erect, smooth or slightly glandular, 10-30 cm. high; lowest leaves petioled, blades oblong, thickish, the upper leaves sessile, white. Common as a weed in cultivated ground.

Apparently introduced from Europe.

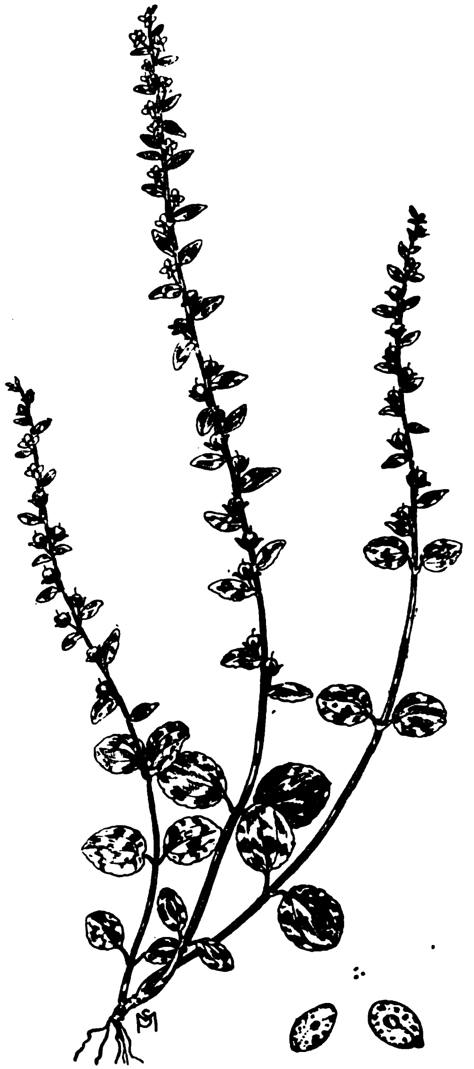


Fig. 193 (170).

Thyme-leaved Speedwell. *Veronica serpyllifolia* L. Perennial, nearly smooth, creeping, much branched, 5-20 cm. high; leaves all opposite and petioled, ovate; racemes loose, corolla whitish or pale blue with deeper stripes. Native and introduced.

PLANTAIN FAMILY. PLANTAGINACEAE.

A small family of herbarious plants, consisting of 200 species, in our region conspicuous for a number of weeds.

One of the peculiarities of the dry fruit in this: when mature it opens all round with a transverse seam.

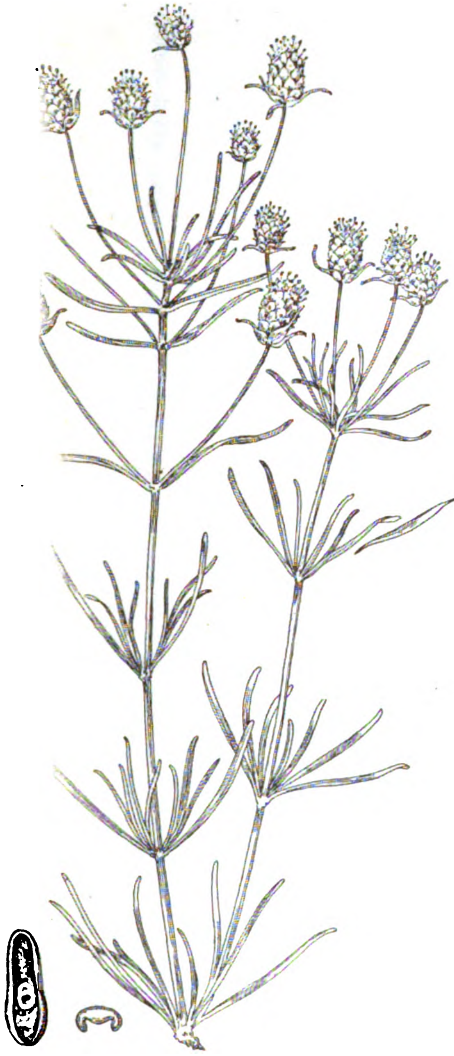


Fig. 194 (171).

Sand Plantain. *Plantago arenaria* W. & K. A pubescent and somewhat viscid annual; leaves 60-30 cm. high; narrow, opposite or whorled; pod one-seeded.

Found at Harrisville, introduced with clover seed, originally from Central Europe.

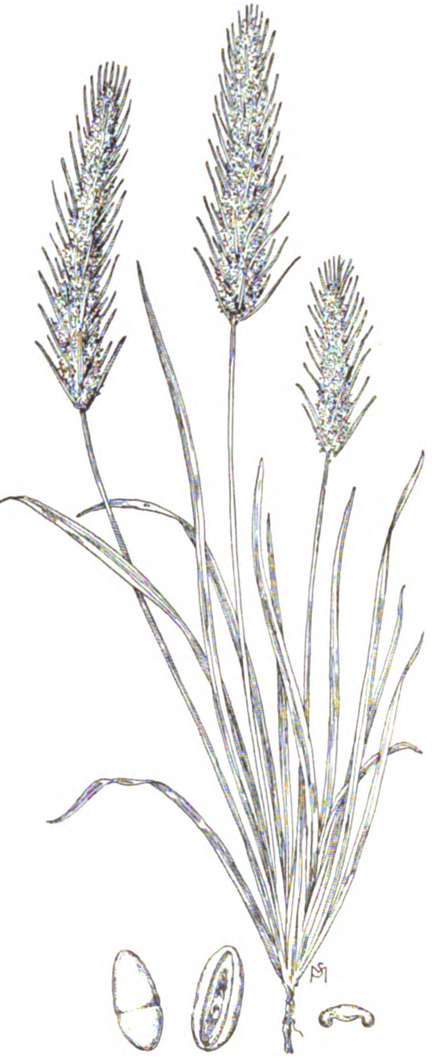


Fig. 195 (172).

Large-bracted Plantain. *Plantago aristata* Michx. A dark green annual, usually hairy, 15-30 cm. high; leaves narrow, entire, often three-ribbed; spikes dense, 4-12 cm. long.

Often introduced from the west with clover seed; so far not usually spreading in Michigan.

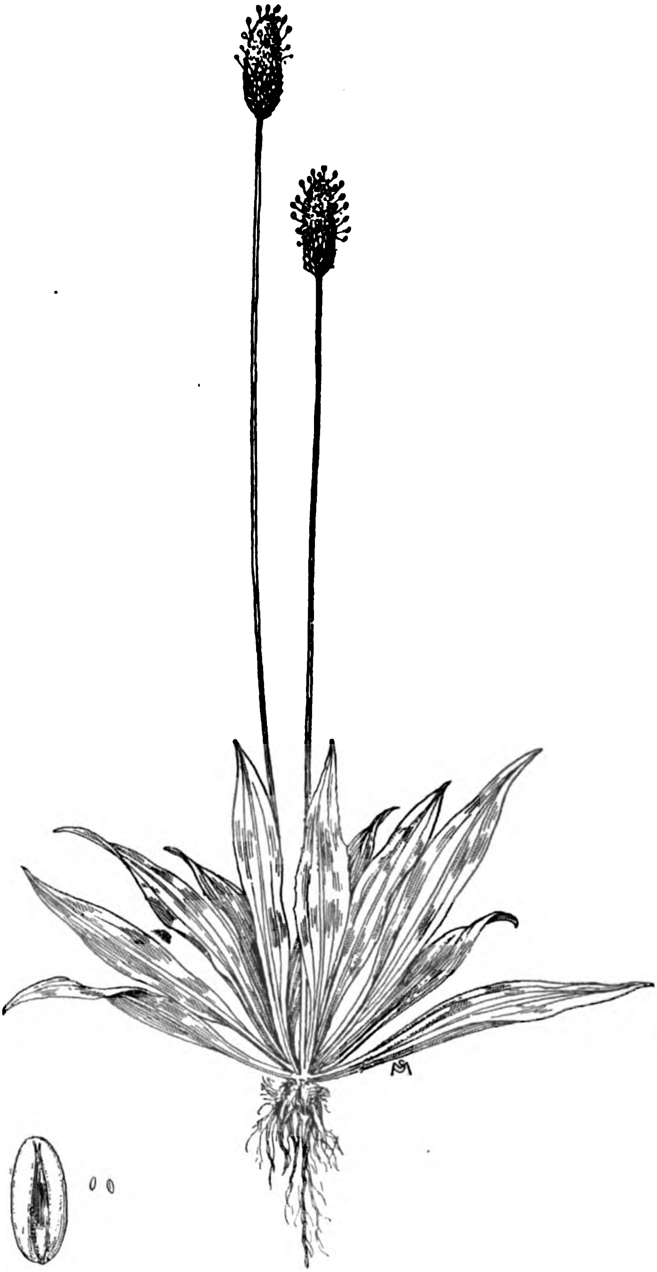


Fig. 196 (173).

Rib-grass. Narrow-leaved Plantain. Buckhorn. *Plantago lanceolata* L. Mostly perennial, more or less hairy, 30-50 cm. high; leaves narrow, 3-5 ribbed, oblong-lanceolate, entire.

Naturalized from Europe, one of our very worst weeds, as its seeds cannot be readily separated from seeds of red clover; and it springs up very quickly after the lawn mower, becoming very unsightly.

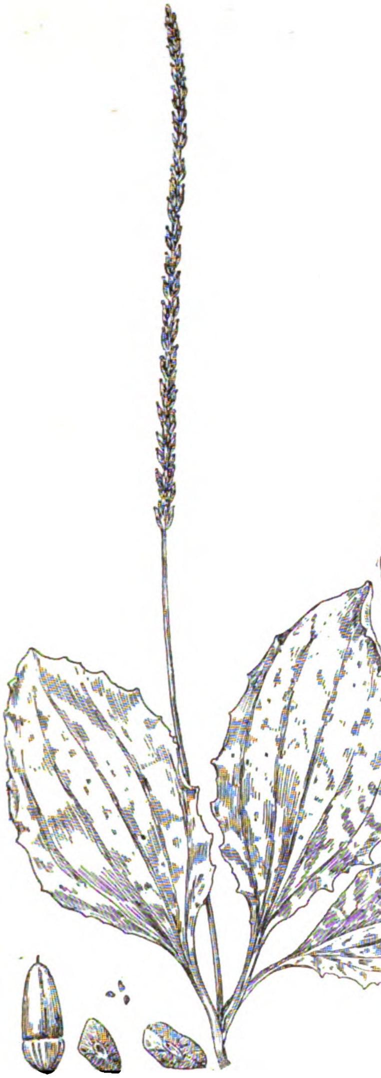


Fig. 197 (175).

Rugel's Broad-leaved Plantain. *Plantago Rugelii* Decne. Leaves thinner, always crimson at base, spikes thin, 30-60 cm. high. This species has invaded fields of the farm and become a serious pest; often found in seeds of red clover, a native to some portions of our country.

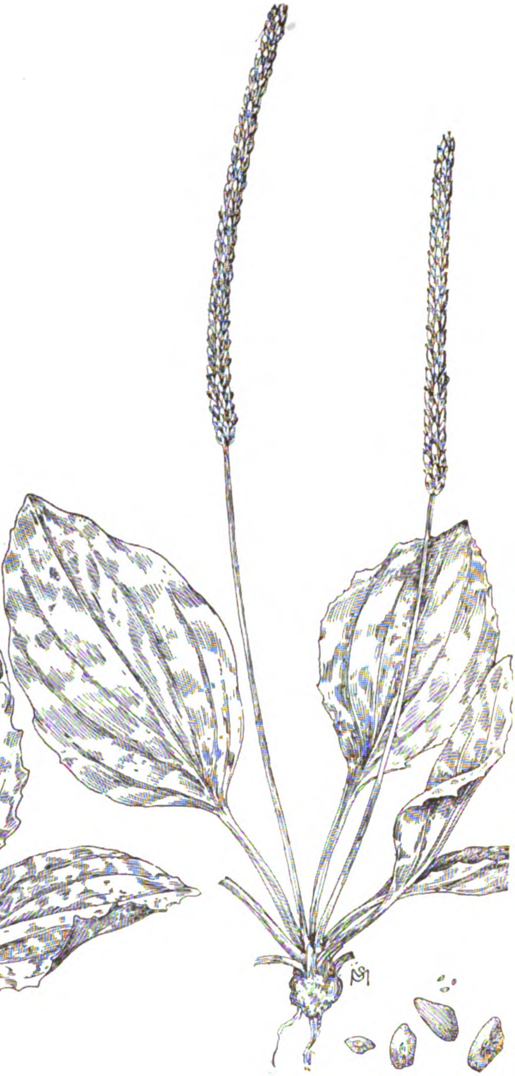


Fig. 198 (174).

Broad-leaved Plantain. *Plantago major* L. Perennial, smooth or hairy, 15-90 cm. high; leaves light green, 3-11-ribbed, base of all leaves without tinge of crimson.

Possibly a native of some region of North America. Not a vigorous weed in Michigan.

MADDER FAMILY. RUBIACEAE.

An immense family of 5,500 species of wide geographical distribution, abundant in tropical regions The coffee plant belongs here, Partridge berry, Bed Straw, Button Bush. One weed is noticed Here are a few of the common names applied to species of *Galium*: **Cleavers, Goose-grass, Bushead Clover-grass, Cling-rascal.**

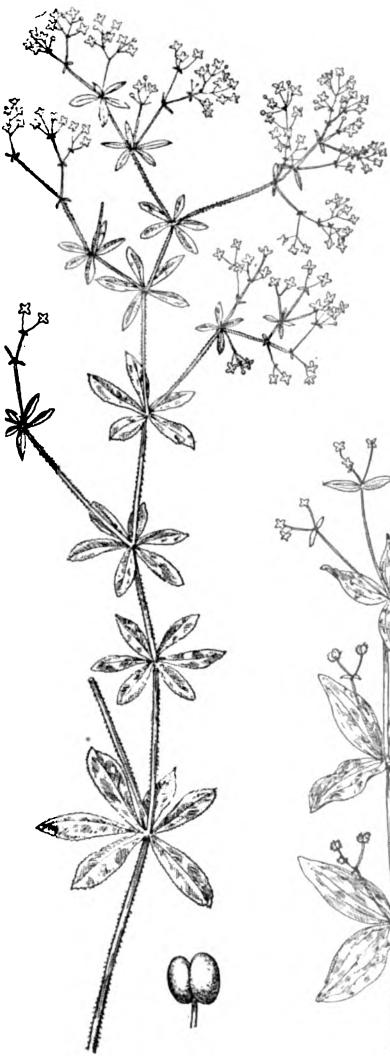


Fig. 199.

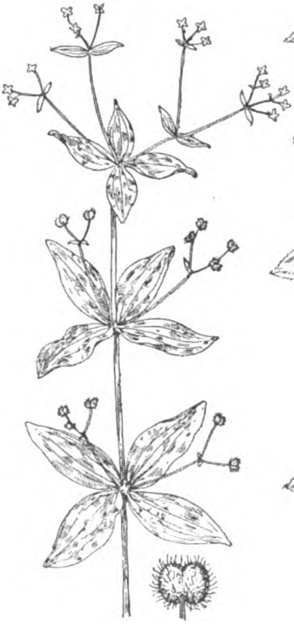


Fig. 200.

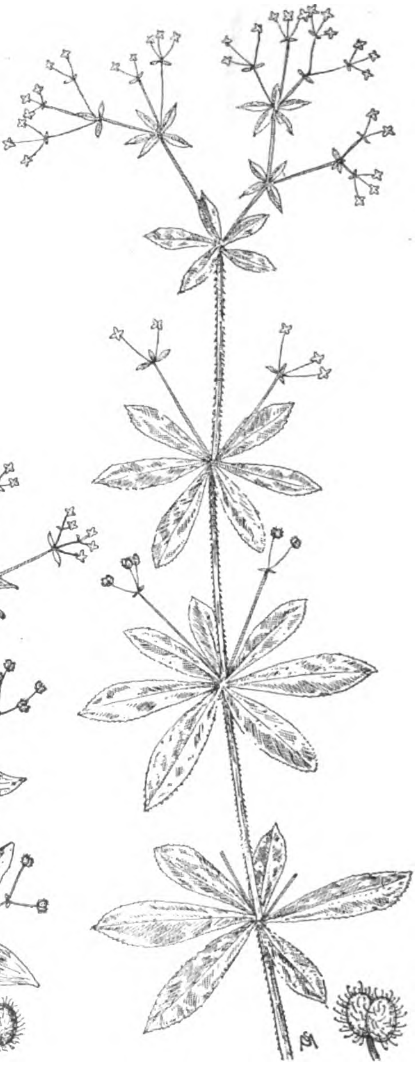


Fig. 201.

Fig. 199. *Galium asprellum* Michx.

Fig. 200. *G. circaezans, G. lanceolatum, G. pilosum, G. trifidum, G. boreale.*

Fig. 200a (176). **Blue Field Madder.** *Sherardia arvensis* L. Through an oversight no drawing of 200a was prepared. A slender, tufted, roughish, prostrate plant, 7-25 cm. high; leaves in fours and sixes, narrow; fruit crowned with the 4-6, calyx teeth. Introduced into this country from Europe and spreading with clover seed.

Fig. 201. **Sweethearts.** *Galium Aparine* L. Annual, weak, climbing over plants, by means of stout, recurved prickles on the stems, 60-150 cm. high; leaves in sixes and eights, narrow; in 1-3-flowered clusters; fruit densely covered with sharp hooked bristles. Widely distributed under some 70 common names; probably introduced from Europe.

A considerable number of other species of *Galium*, such as *G. lanceolatum, G. pilosum, G. trifidum G. boreale*, mostly natives grown in woods becomes a pest to sheep, if allowed to roam about in late summer and autumn.

TEASEL FAMILY. DIPSACACEAE.

A very small family of coarse herbs consisting of only 140 species. Natives of the old world. Species of scabious are grown for ornament. The fuller's teasel is grown for the purpose of placing the ripened heads with their stiff-hooked prickles in revolving frames to produce nap on cloth.

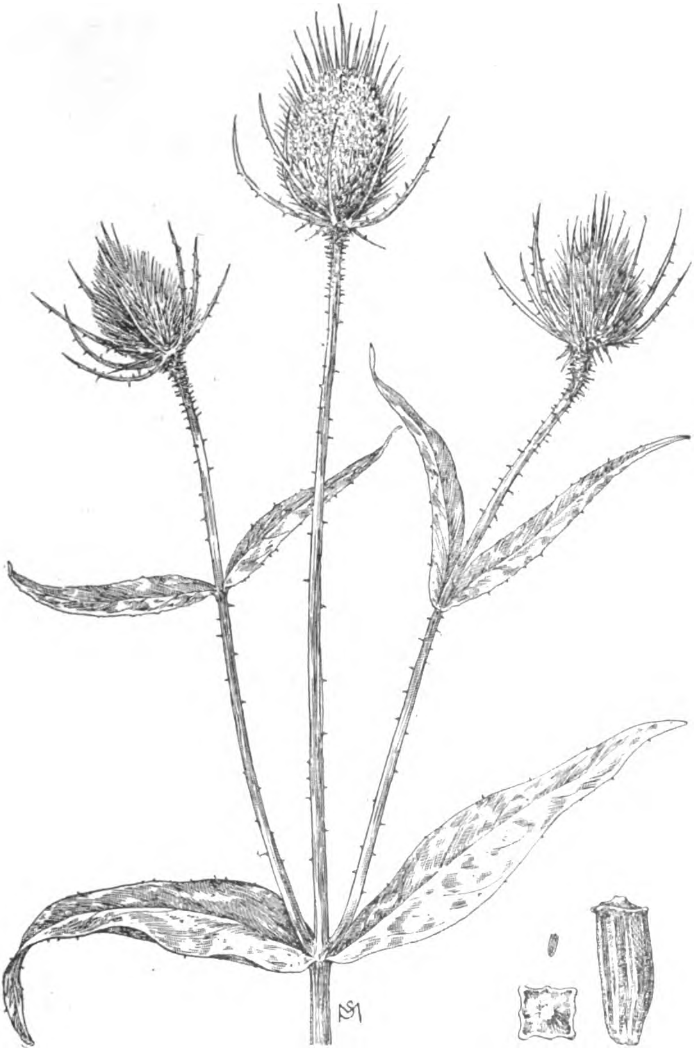


Fig. 202 (177).

Common Teasel. *Dipsacus sylvestris* Huds. A coarse, prickly biennial, 60-180 cm. high leaves sessile, opposite; heads 7-10 cm. long; flowers lilac in color. Waste places rom Europe.

THE THISTLE FAMILY. THE ASTER FAMILY. COMPOSITE FAMILY. COMPOSITAE.

This includes the Chicory Family and the Ragweed Family, sometimes considered as distinct from the Compositae. Botanically this family ranks highest of any. In the most comprehensive sense this immense family of seed plants consists of 11,450 species—much the largest of all. The flowers are produced in heads; the anthers are united into a tube which surrounds the style; there is only one seed to a flower.

Here are found large numbers of showy flowers in cultivation, such as asters, dahlias, chrysanthemums and the largest contributions to the weeds of any family. To the vegetable garden the best it can do is to furnish lettuce, endive, chickory, artichokes, sunflowers. It does not furnish a single plant of importance for meadows or pastures possibly excepting yarrow, which takes a low rank for meadow, pasture and lawn.

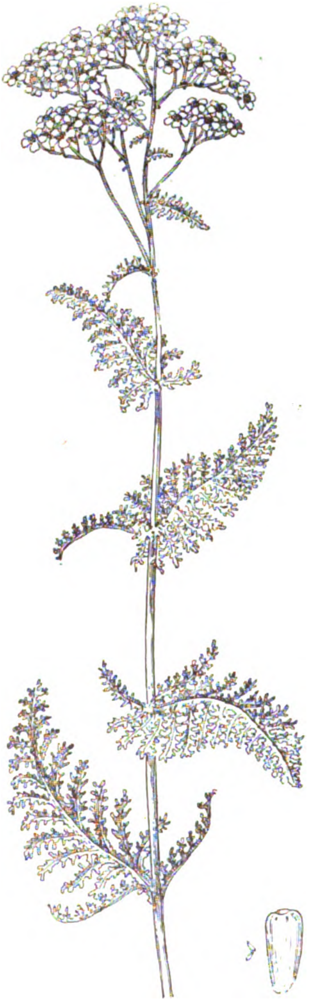


Fig. 203 (178).

Yarrow. Milfoil. *Achillea Millefolium* L. Stems simple, slightly woolly, perennial from horizontal rootstocks, 30-60 cm. high; leaves many times finely dissected into almost thread like pieces; heads numerous, small, in a flat-topped cluster, ray flowers white or pink. It seems to be native to this country as well as native to Europe.

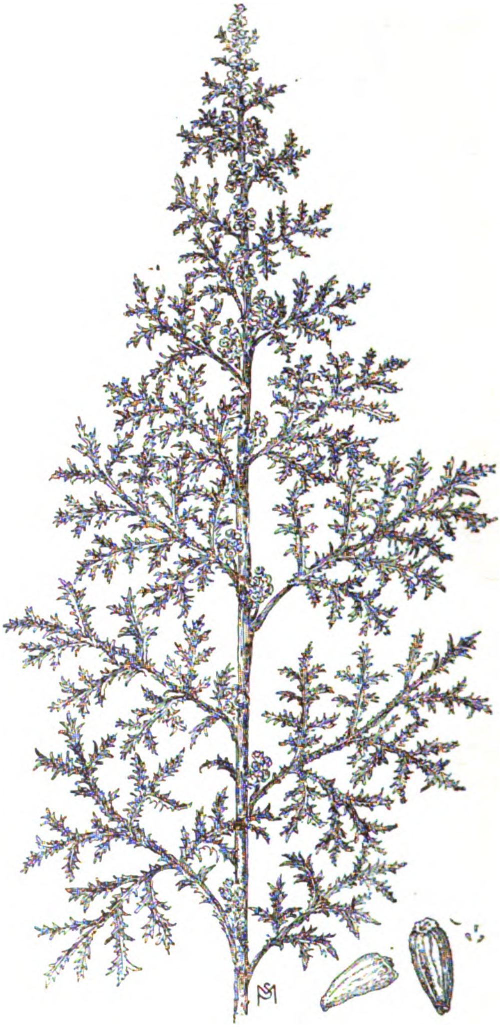


Fig. 204.

Biennial Wormwood. *Artemisia biennis* Willd. An erect, smooth, biennial, 30-120 cm. high; leaves divided; heads crowded in short spikes, very numerous, about 3 mm. broad. Introduced into moist ground from the west.

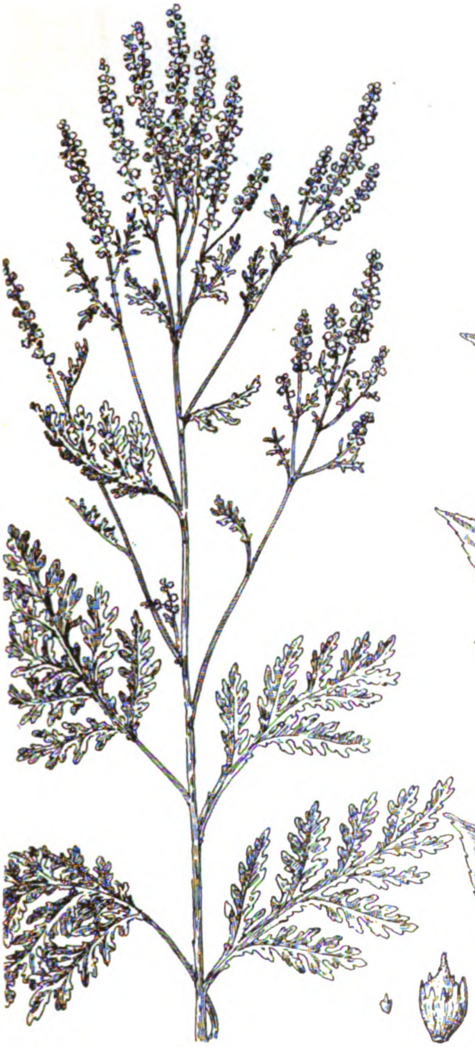


Fig. 205 (179).

Ragweed. Hogweed. *Ambrosia artemisiifolia* L. A hairy, much branched, very variable annual, 30-180 cm. high; leaves thin, cut lobed; racemes of the male flowers very numerous, female heads clustered above the base of the leaves.

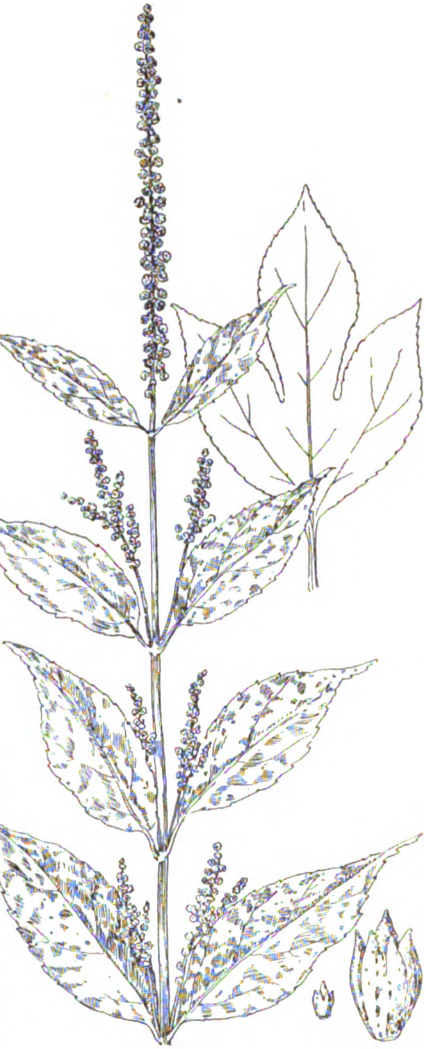


Fig. 206 (180).

Great Ragweed. King Head. *Ambrosia trifida* L. A rough or nearly smooth, branched annual, 1-6 m. high; leaves deeply 3-5-lobed; racemes of male heads 4-20 cm. long, female heads clustered above the leaves.

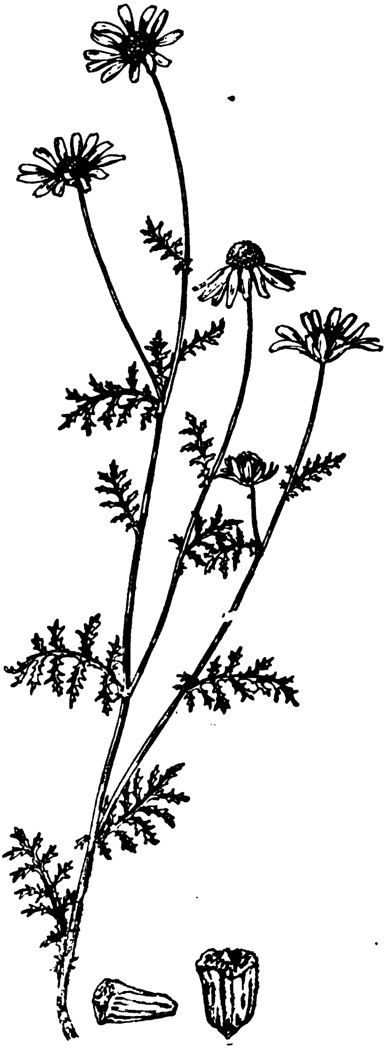


Fig. 207 (181).

Corn Camomile. *Anthemis arvensis* L. Usually annual, not strong scented, finely pubescent, much branched, about 30 cm. high; leaves sessile, on [illegible] or twice cut lobed; heads usually num [illegible] 3-4 cm. broad; the ray flowers white.

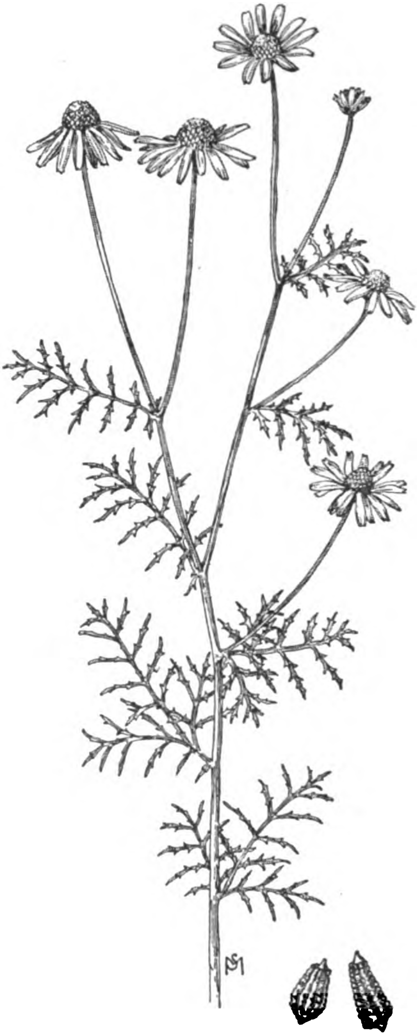


Fig. 208 (182).

May-weed. Dog-fennel. *Anthemis Cotula* L. Annual, ill smelling, much branched, sometimes pubescent, 30-60 cm. high; leaves finely dissected; heads numerous, about 2 5 cm. broad, rays white.

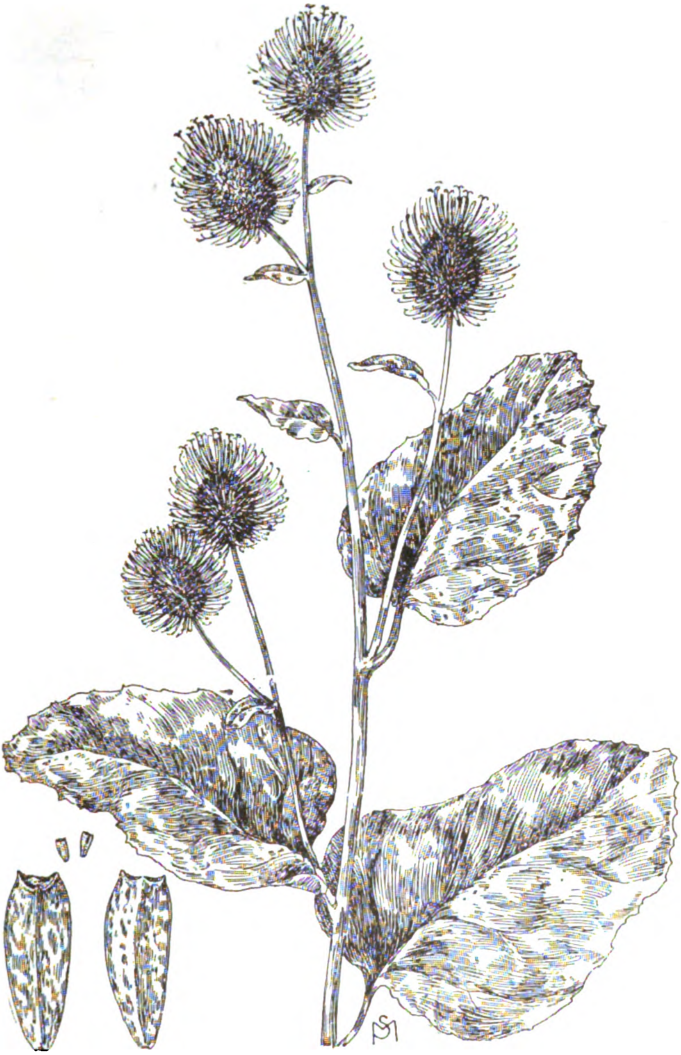


Fig. 209 (183).

Great Burdock. *Arctium Lappa* L. A large, fine-wooly, coarse, biennial, 1-2 m. high; leaves large mostly heart shaped; heads clustered, 3-5 cm. broad, the outside scales hooked at the top making a formidable bur; flowers purple.

So far as the writer has observed, there are no plants of this species in the state, the following species having heretofore passed for this one. Introduced from Europe.

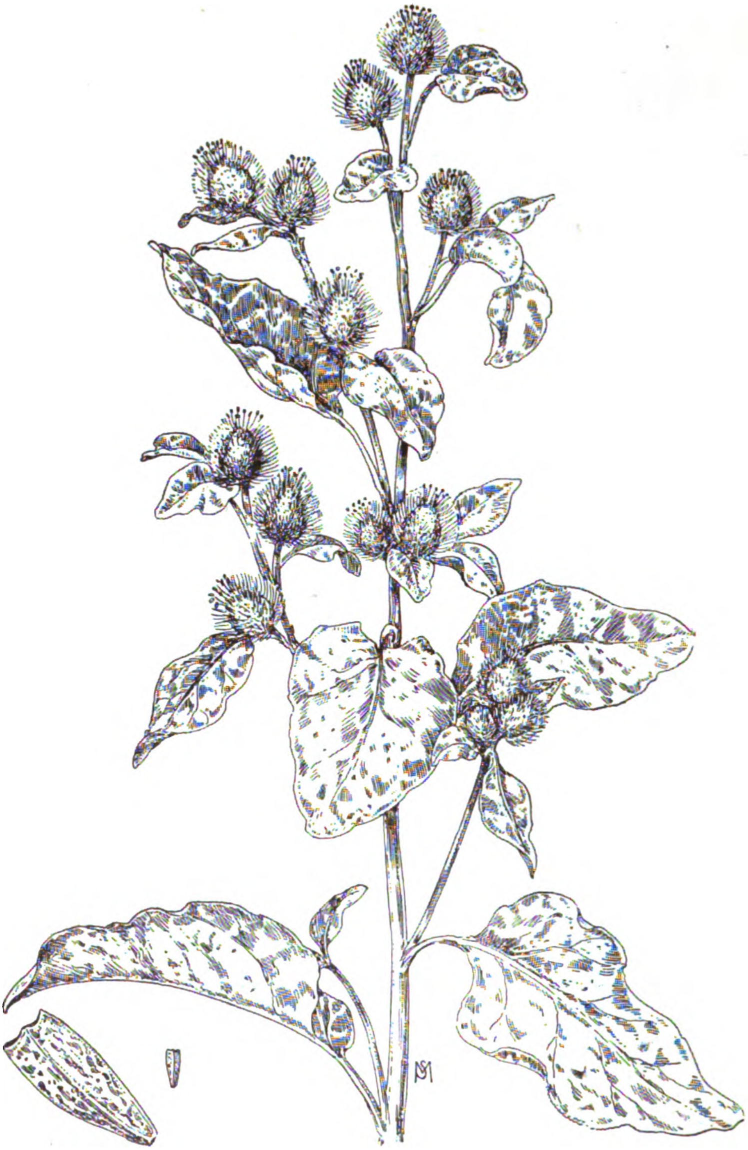


Fig. 210 (183).

Common Burdock. *Arctium minus* Bernh. A large, fine-wooly, coarse, biennial, 1-2 m. high; leaves mostly heart shaped; heads clustered, 1.5-3 cm. broad, bracts hooked at the apex; flowers purple; abundant in certain portions of the state.

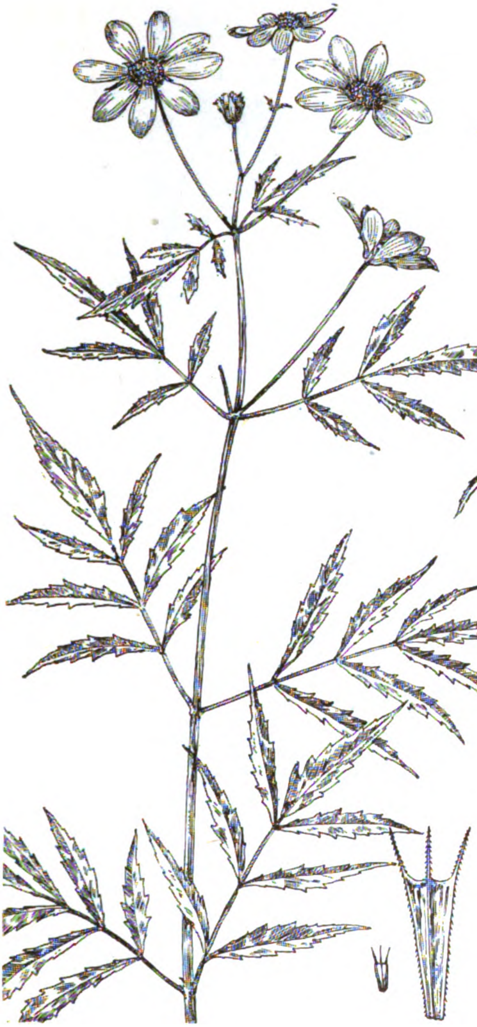


Fig. 211.

Western Tickseed. *Bidens aristosa* (Mich.) Britton. Annual or biennial, much branched, more or less pubescent, 30-90 cm. high; leaves thin, lobes narrow; heads numerous, ray flowers 6-9, showy; achenes flat, upwardly ciliate bearing two parallel teeth.

A native found in swamps and wet land.

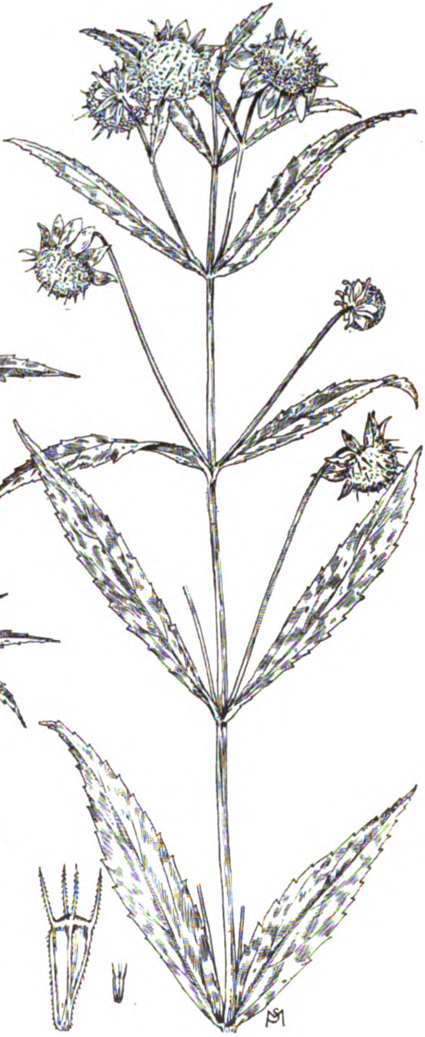


Fig. 212 (185).

Stick-tight. Nodding Bur. Marigold. *Bidens cernua* L. Erect, branched, smooth or rough, annual, 20-70 cm. high; leaves narrow, clasping the stem at the base; heads globose, nodding; ray flowers yellow, 6-10 or more.

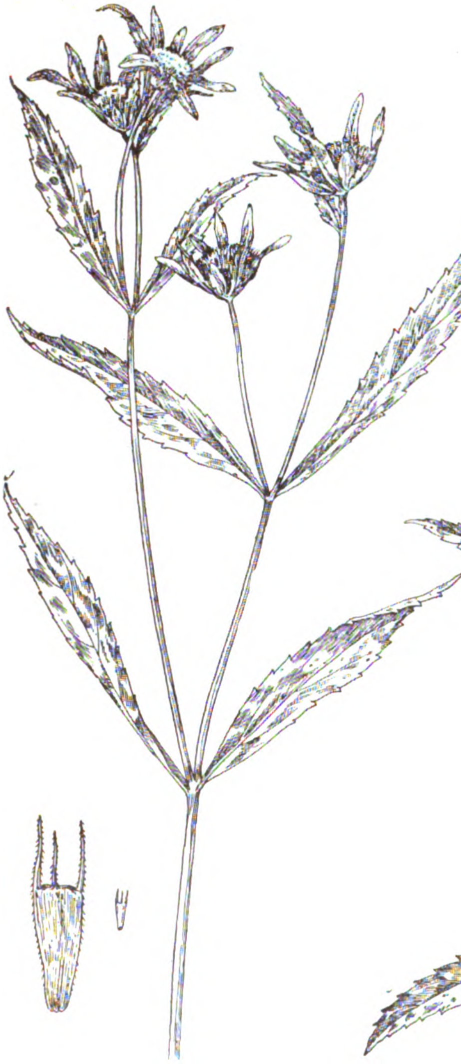


Fig. 213.

Leafy-bracted Tickseed. *Bidens comosa* (A. Gray) Wiegand. A smooth, straw colored annual, 15-120 cm. high; leaves narrow, not compound; heads few, large; ray flowers wanting; achenes about 1 cm. long, nearly smooth, awns, three-barbed downward.

A native, growing in wet soil.

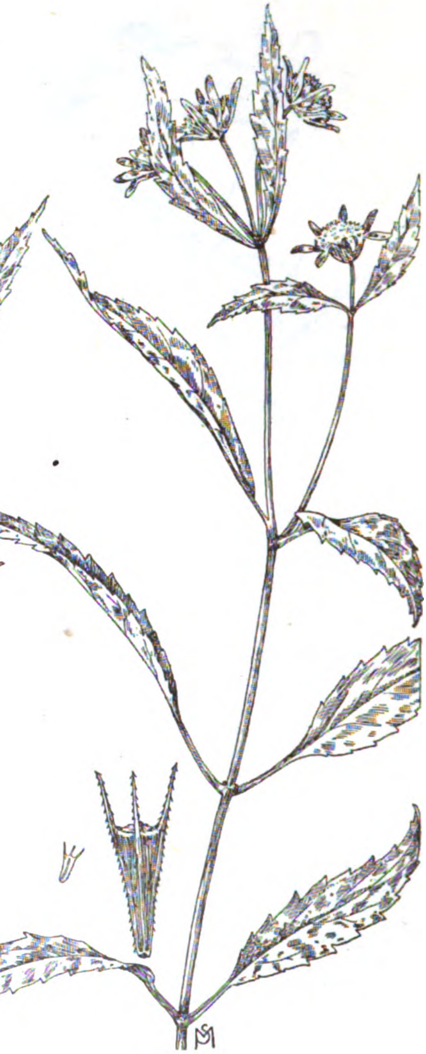


Fig. 214 (186).

Purple-stemmed Swamp Beggar-ticks. *Bidens connata* Muhl. A smooth, purple, erect, much-branched annual, 15-200 cm. high; leaves narrow; ray flowers none or small.

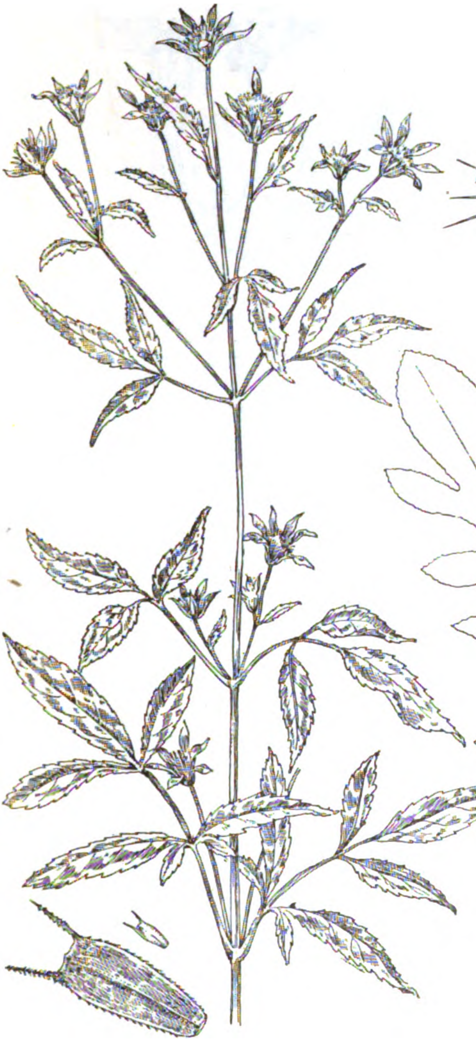


Fig. 215 (187).

Beggar Ticks. Stick-tight. *Bidens frondosa* L. An erect, branched, mostly smooth, annual, 60-250 cm. high; leaves thin, 3-5 divided, the sections narrow; rays none; achenes flat, oval, the two slender awns barbed downward. Damp soil.

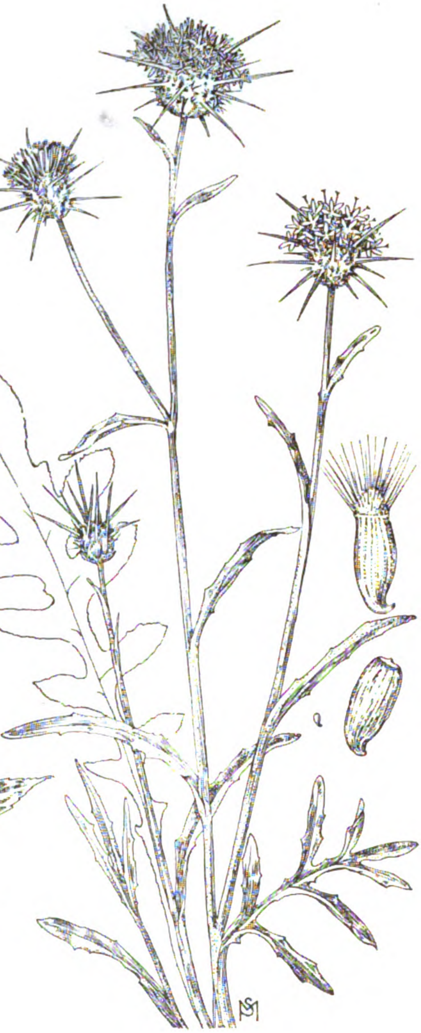


Fig. 216 (188).

Star Thistle. *Centaurea solstitialis* L. A straggling plant, gray, with loose wooly hairs, 30-50 cm. high; stem leaves small, narrow, each with one margin growing down the stem; heads about 1.5 cm. broad, some of the stout spiny scales yellow, spreading, 12-18 mm. long.

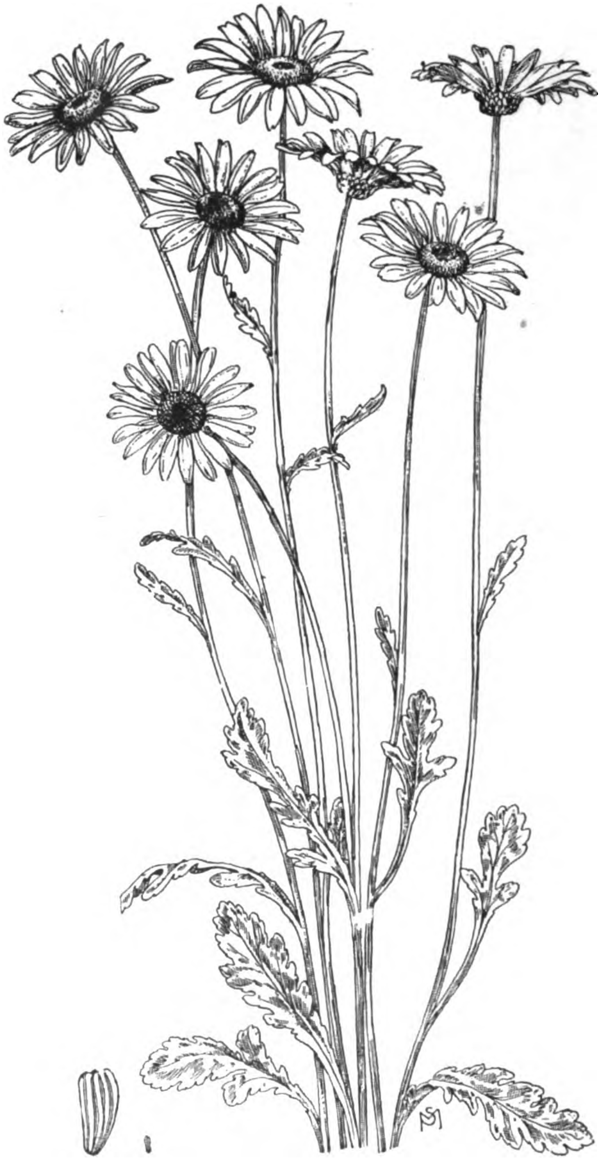


Fig. 217 (189).

Ox-eye Daisy. *Chrysanthemum Leucanthemum pinnatifidum* Lecoq and Lamotte. Stem erect, branching but little, 30-50 cm. high, perennial from spreading rootstocks; lower leaves mostly spatulate, stem leaves partly clasping; heads 4-6 cm. broad, with 20-30 white rays. Not yet very common in Michigan.

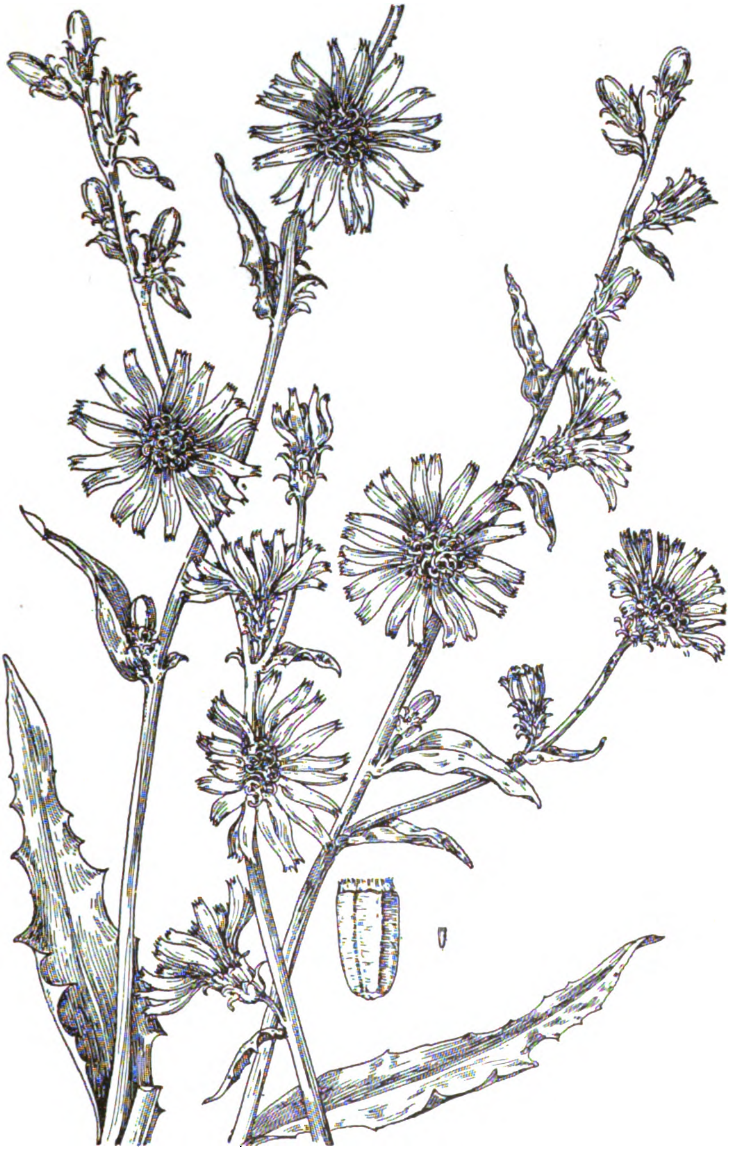


Fig. 218 (190).

Chicory. Blue Sailors. *Cichorium Intybus* L. Whole plant pervaded by milky juice; stem stiff, rough, much branched perennial, 30-90 cm. high, from a long, deep top-root; leaves long, narrow, variable; heads numerous; flowers bright blue.

Waste places, introduced from Europe. Sometimes cultivated for use of the roots as a substitute for coffee or to mix with coffee.

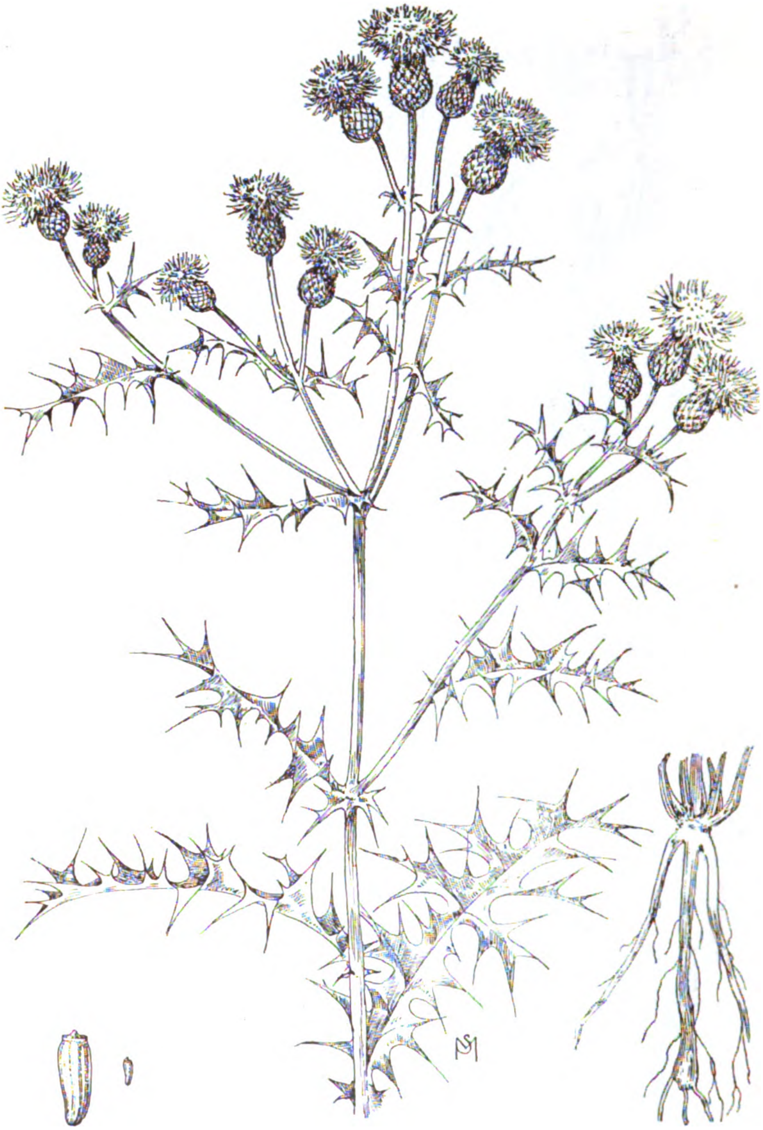


Fig. 219 (191).

Canada Thistle. *Cirsium arvense* (L.) Scop. (*Carduus arvensis* (L.) Robs.) A slender, nearly smooth perennial, 30-90 cm. high from extensively creeping rootstocks; leaves narrow, the margins bending irregularly up and down, backward and forward, each lobe always terminating in a sharp stiff point; flowers rose purple or whitish; scales of the heads not bristly pointed; each seed as it grows usually produces a male plant or a female plant; by rootstocks a half acre or more is often the result of a single seed.

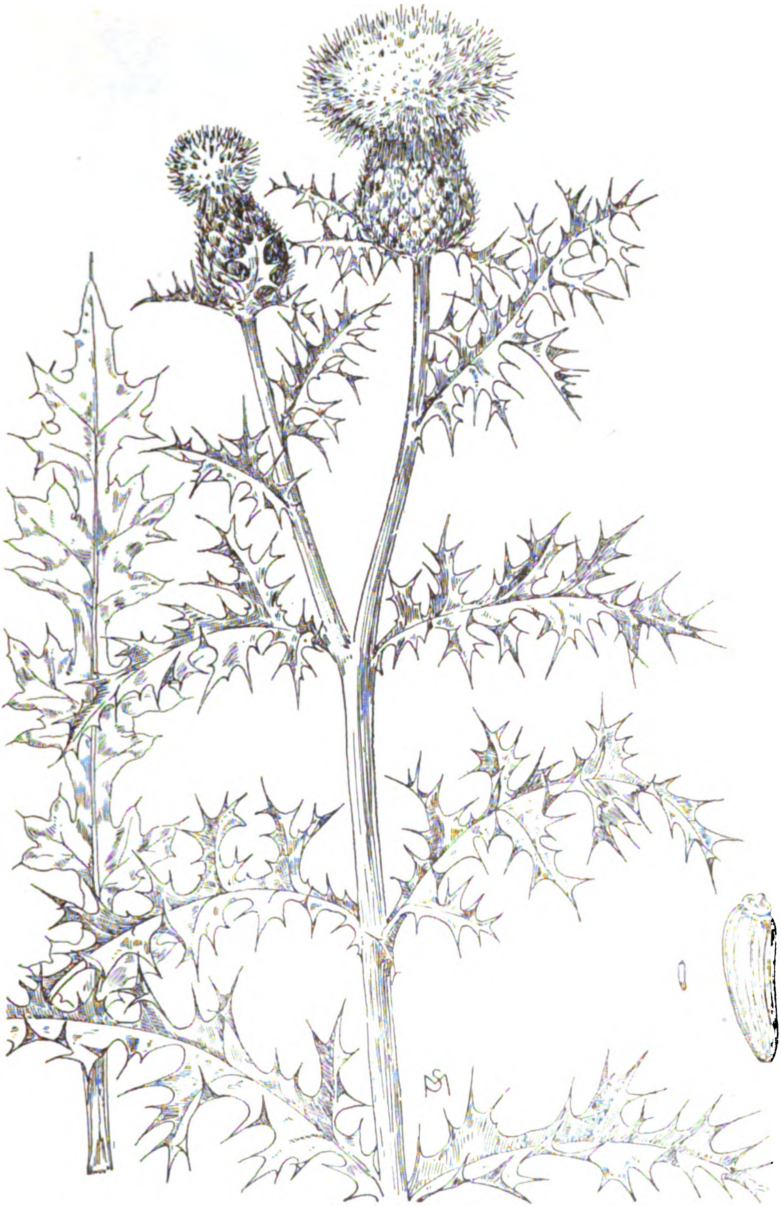


Fig. 220 (192).

Common or Bull Thistle. *Cirsium lanceolatum* (L.) Hill. (*Carduus lanceolatus* L.) A stout, woolly, branched biennial, 90-150 cm. high; leaves variably lobed, extending down the stem (decurrent), everywhere each wavy lobe terminates in a formidable prickle; heads large, mostly solitary, the scales of the involucre each terminating in a bristly prickle.

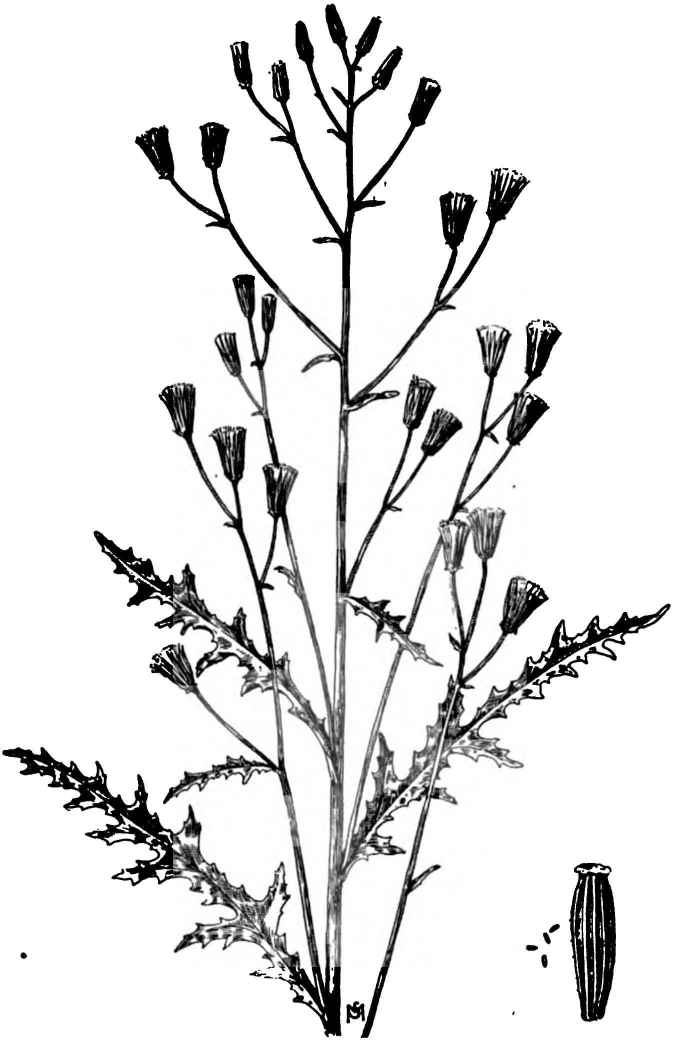


Fig. 221 (194).

Fire-weed. *Erechtites hieracifolia* (L.) Raf. Annual, mostly smooth, erect, coarse, homely plants with a rank smell, 30-180 cm. high; leaves narrow, variable.

A native plant, springing up in recently burned clearings and where low land has been cultivated. Sometimes harvested in quantities and distilled for the oil.

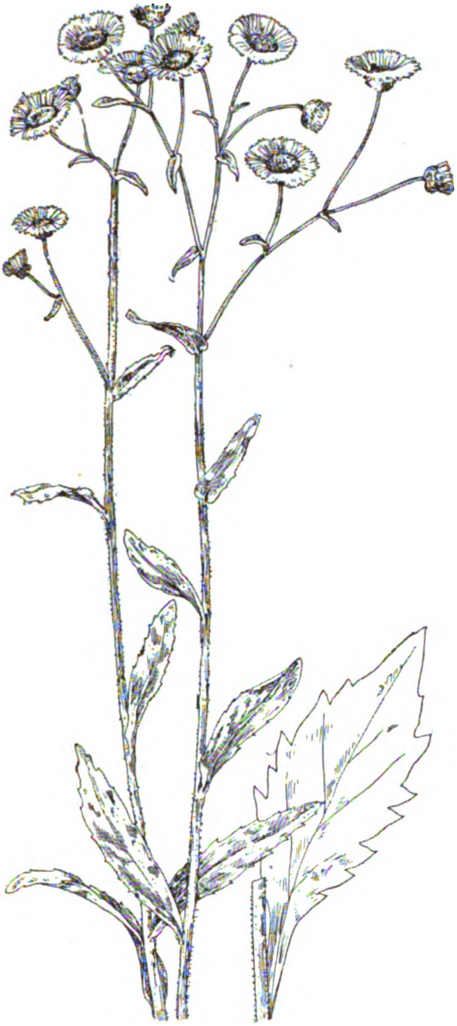


Fig. 222 (196).

Daisy Fleabane *Erigeron annuus* (L.) Pers. A rather slender, erect, leafy biennial, 20-150 cm. high, beset with spreading hairs, lower leaves ovate, mostly obtuse, coarsely toothed, upper narrower, sharply toothed, marginal flowers very numerous, white or tinged with purple. Study well and com-pare with *Erigeron ramosus*. The achenes are so nearly like those of *E. ramosus* that it did not seem worth while to make drawings of the species.

A native weed; especially abundant in thin grass land.

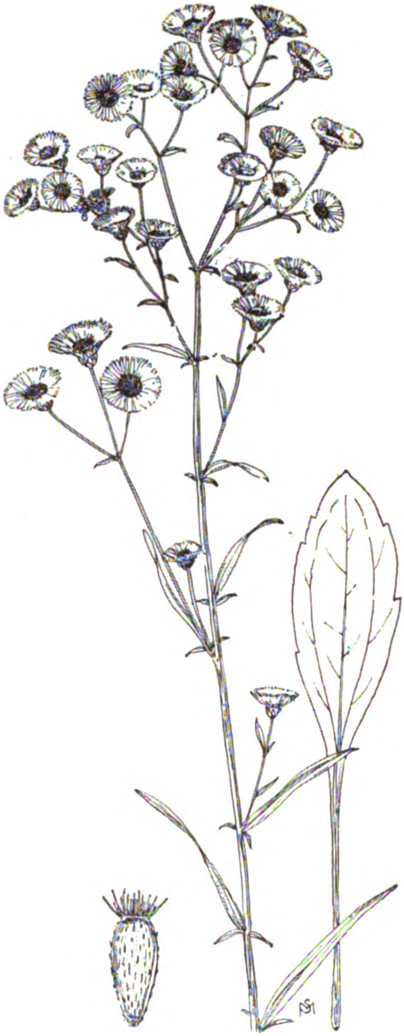


Fig. 223 (196).

Daisy Fleabane. *Erigeron ramosus* (Walt.) B. S. P. Slender, erect, biennial, pubescence closely appressed, 60-150 cm. high; stem-leaves narrow, mostly entire, closely resembles *E. annus* with which carefully compare; found together in similar places, though this species likes sandy and gravelly soil. Stem smaller and more simple than the preceding, with smaller heads but longer rays.

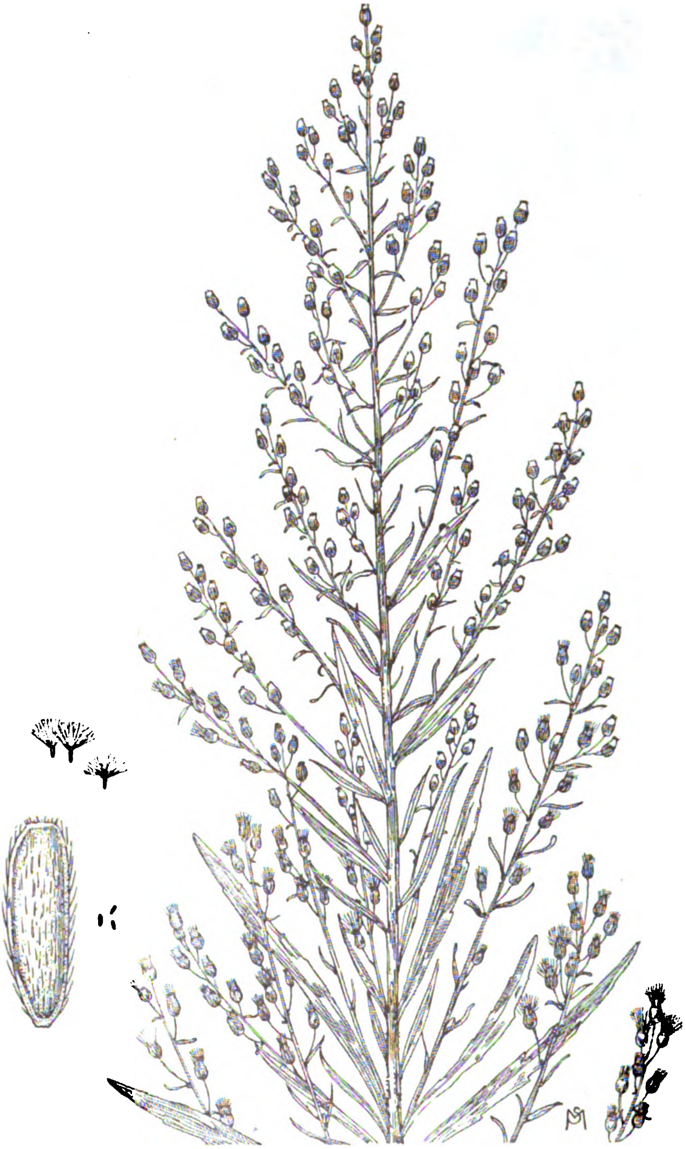


Fig. 224 (195).

Horse-weed. Mare's-tail. A Fleabane. *Erigeron canadensis* L. (*Leptilon canadense* (L.) Britton.) Erect, bristly-hairy, 60-270 cm. high; leaves very numerous,, very narrow; heads very numerous, bearing very short rays on the margins. A native plant now of wide distribution at home and abroad. Waste places, common and abundant. Sometimes cut and distilled for the oil.

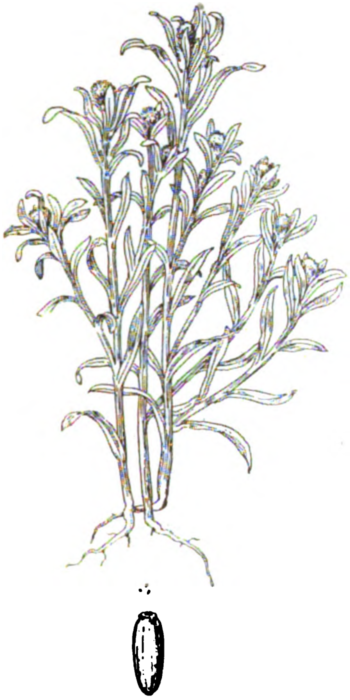


Fig. 225 (198).

Low Cudweed. *Gnaphalium uliginosum* L. Annual, much branched from the base, covered all over with appressed wool, 5-30 cm. high; leaves narrow, spatulate; heads small in clusters, bracts brownish.

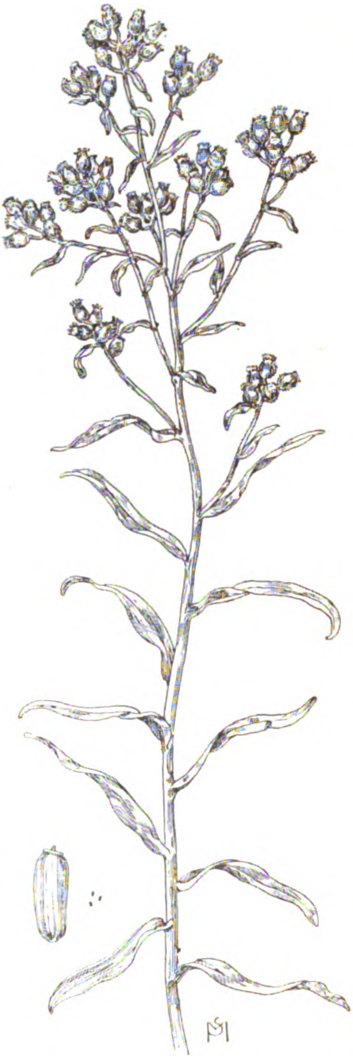


Fig. 226 (197).

Sweet Life Everlasting. *Gnaphalium polycephalum* Michx. (*G. obtusifolium* L.) Erect, annual or winter annual, fragrant, fine, woolly, 30-70 cm. high; leaves narrow, heads small, numerous, the bracts on the outside whitish, thin, paper-like (scarious).

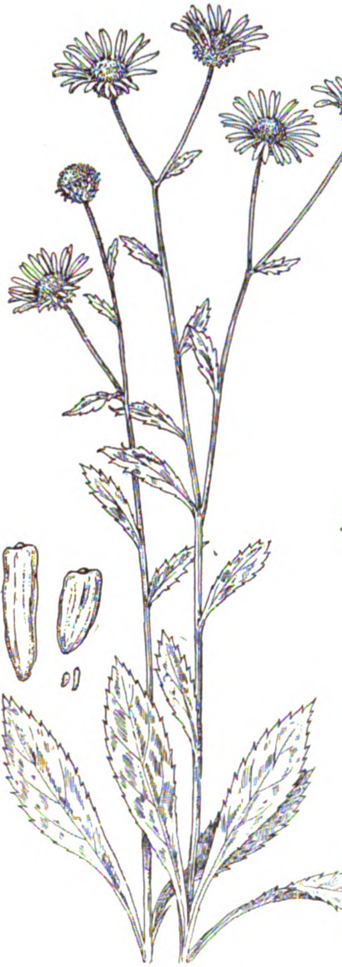


Fig. 227 (199).

Broad-leaved Gum-plant. Tar-weed. *Grindelia squarrosa* (Pursh) Dunal. Perennial or biennial, smooth, erect, 20-60 cm. high; leaves narrow; often spatulate, base more or less clasping; bracts of the involucre strongly spreading, very glutinous, flowers yellow, native in the west, introduced with seeds of clover and grasses.

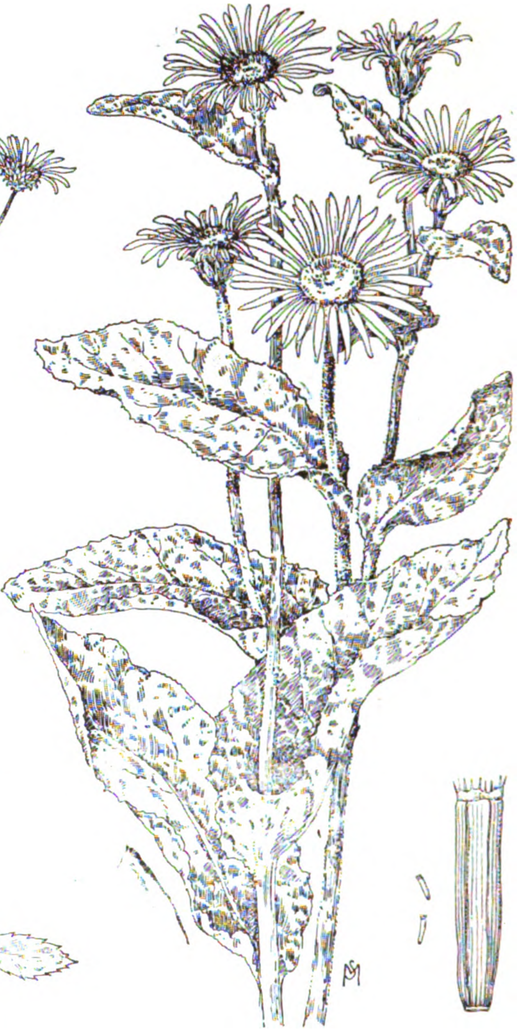


Fig. 228 (202).

Elecampane. *Inula Helenium* L. A coarse, stout, erect, pubescent perennial, 60-180 cm. high; lower leaves ovate, petioled, 20-45 cm. long, the upper partly clasping; ray flowers yellow, numerous.

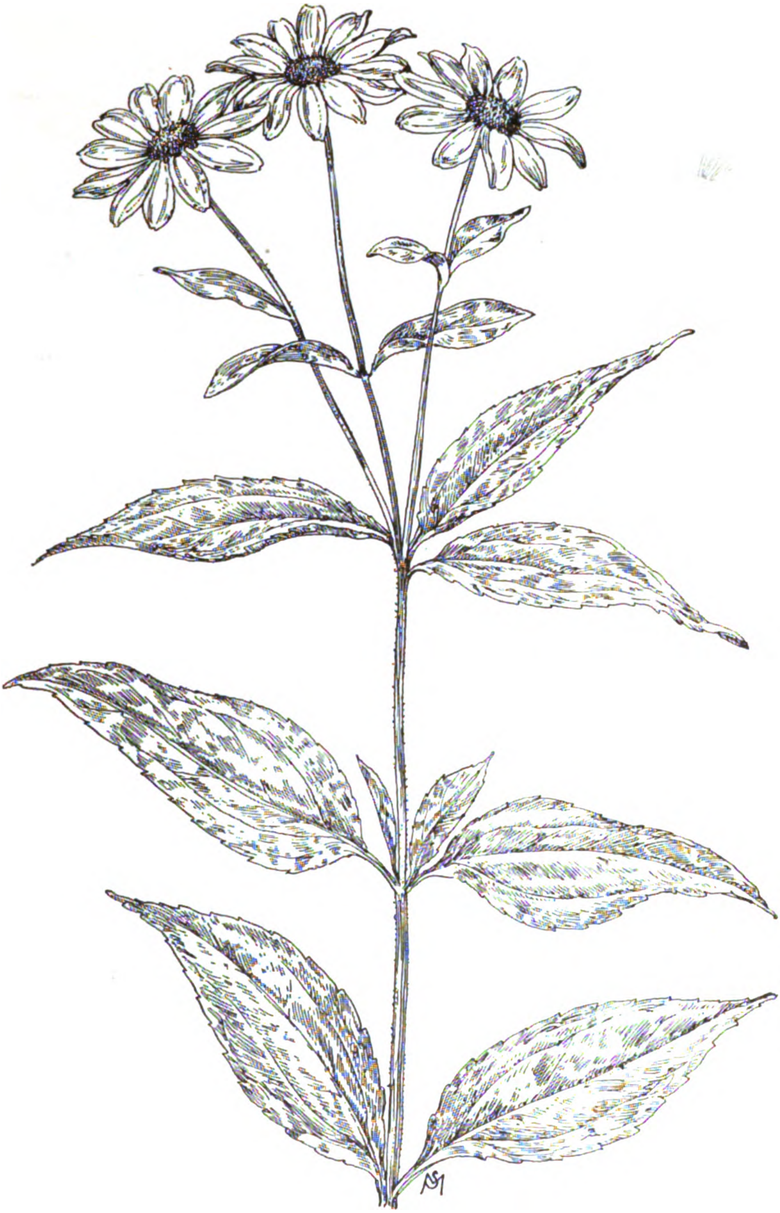


Fig. 229.

Jerusalem Artichoke. *Helianthus tuberosus* L. Stem rough, stout, branched, 120-300 cm. high, perennial by numerous tubers; leaves ovate or narrow, three-nerved, sharp pointed; rays 12-20, yellow, occasionally cultivated and spreading as a weed.

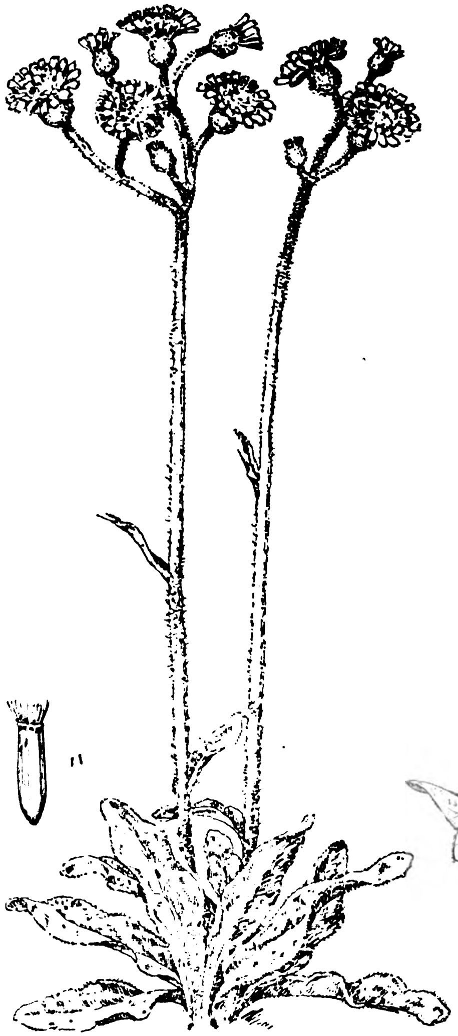


Fig. 230 (200).

Devil's Paint-brush. Orange Hawkweed. *Hieracium aurantiacum* L. A slender, thin, hairy, perennial, 20-60 cm. high, usually spreading by runners, juice milky; leaves mostly at the ground, spatulate; flowers orange-red, showy. Introduced from Europe and escaped from cultivation. A terrific weed when once established.

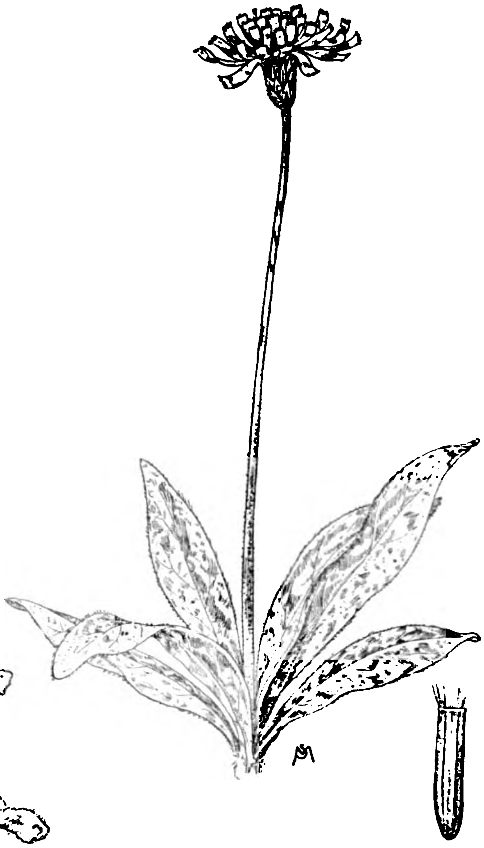


Fig. 231 (201).

Mouse-Ear. Hawkweed. *Hieracium Pilosella* L. An erect, thin-hairy, perennial, 10-30 cm. high, spreading by runners, juice milky; leaves mostly at the ground, oblong or spatulate; flowers yellow.

Introduced from Europe, having much the habit of *H. aurantiacum*.

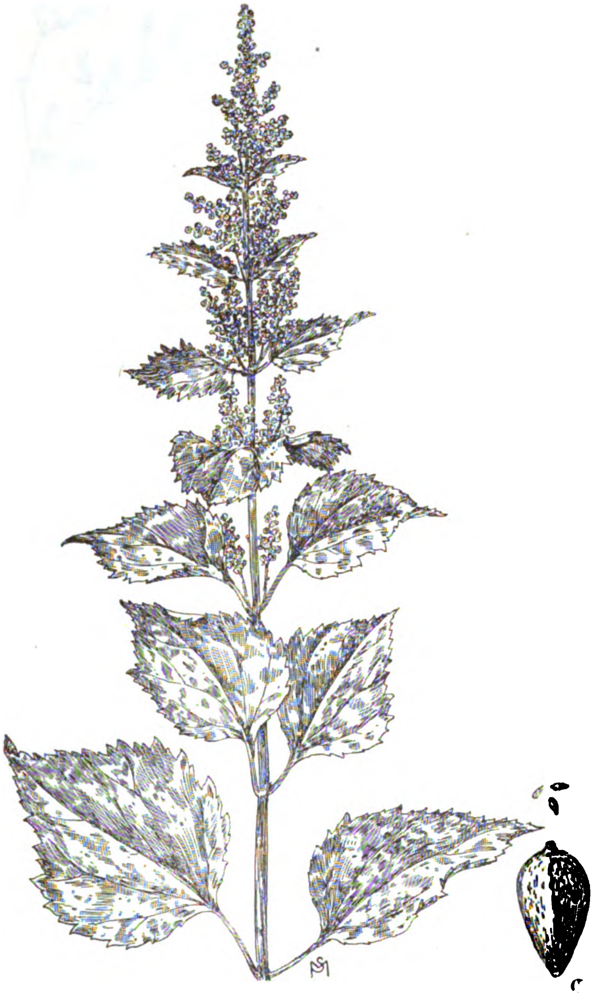


Fig. 232 (203).

Marsh Elder. *Iva xanthiifolia* Nutt. Annual, coarse rough, light colored with minute down, 60-180 cm. high; leaves mostly opposite, ovate or rhombic, three-ribbed, more or less lobed; heads small, crowded in panicles. Waste places in the Upper Peninsula.

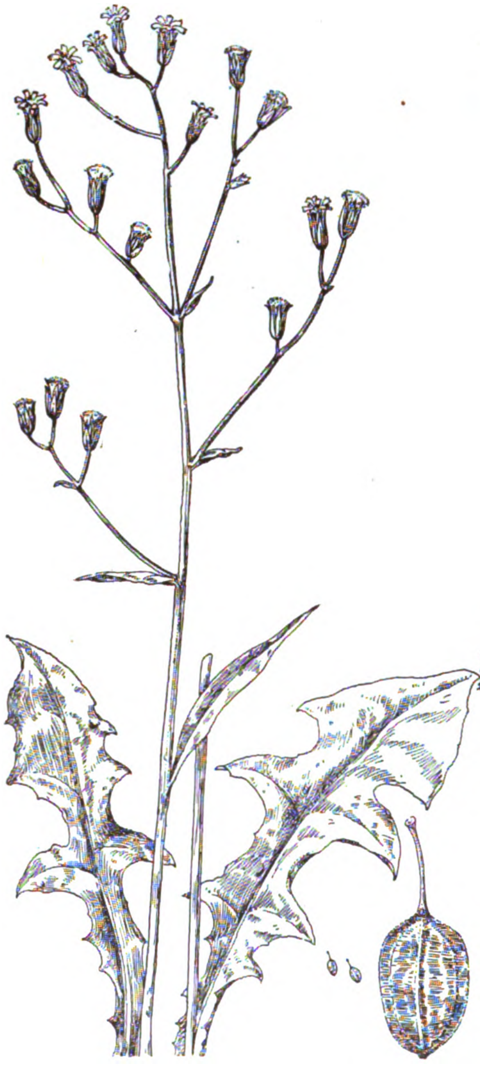


Fig. 233 (204).

Wild or Tall Lettuce. *Lactuca canadensis* L. A smooth, leafy biennial, 1-3 m. or more high, juice milky; leaves more or less lobed or simple, some of them 30 cm. long; heads 1-1.5 cm. long, numerous, in a large open panicle; flowers yellow.

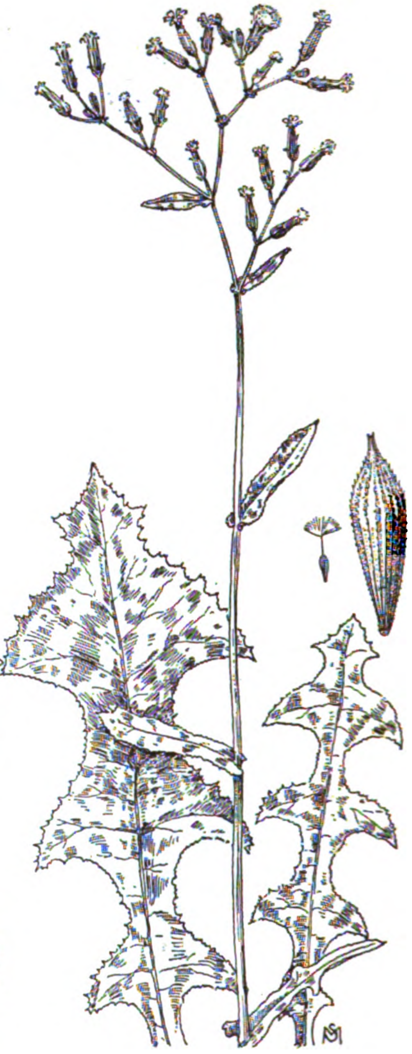


Fig. 234 (205.)

Prickly Lettuce. *Lactuca Scariola* L. Biennial, erect, stiff, leafy, smooth, except near the base, juice milky, 60-200 cm. high; leaves narrow with spinulose margins, base more or less clasping, tending in open places to turn one edge up, the other down, and to point north and south; flowers pale yellow. A troublesome weed introduced from Europe.

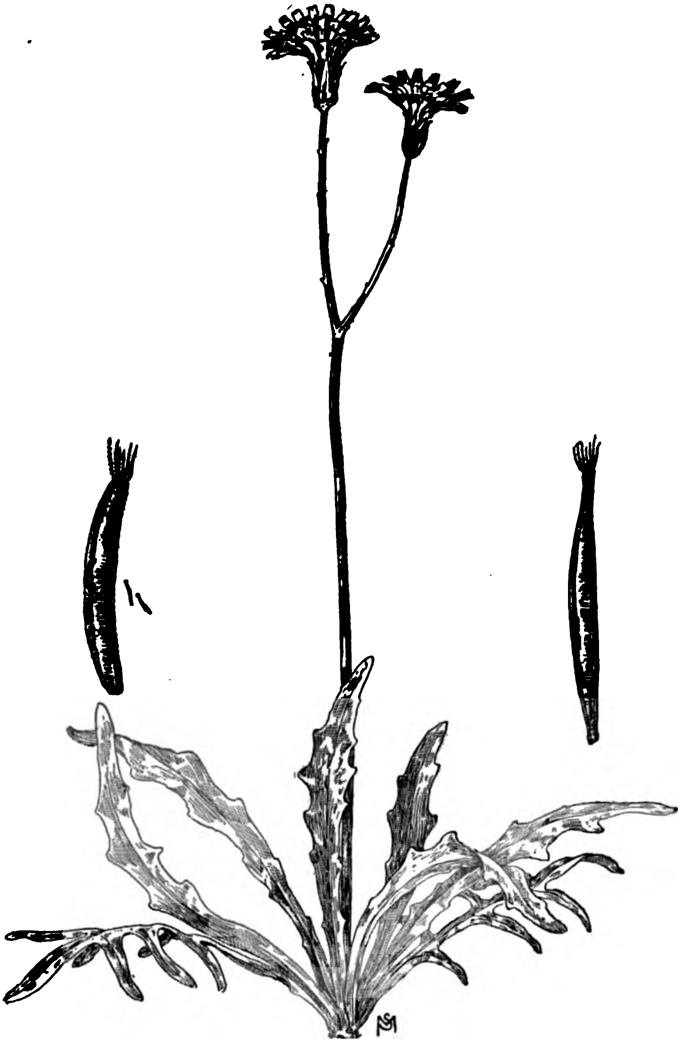


Fig. 235 (206).

Fall Dandelion. *Leontodon autumnalis* L. A smooth perennial, the flower stem slender, 10-60 cm. high, juice milky; leaves narrow, 3-8 cm. long.

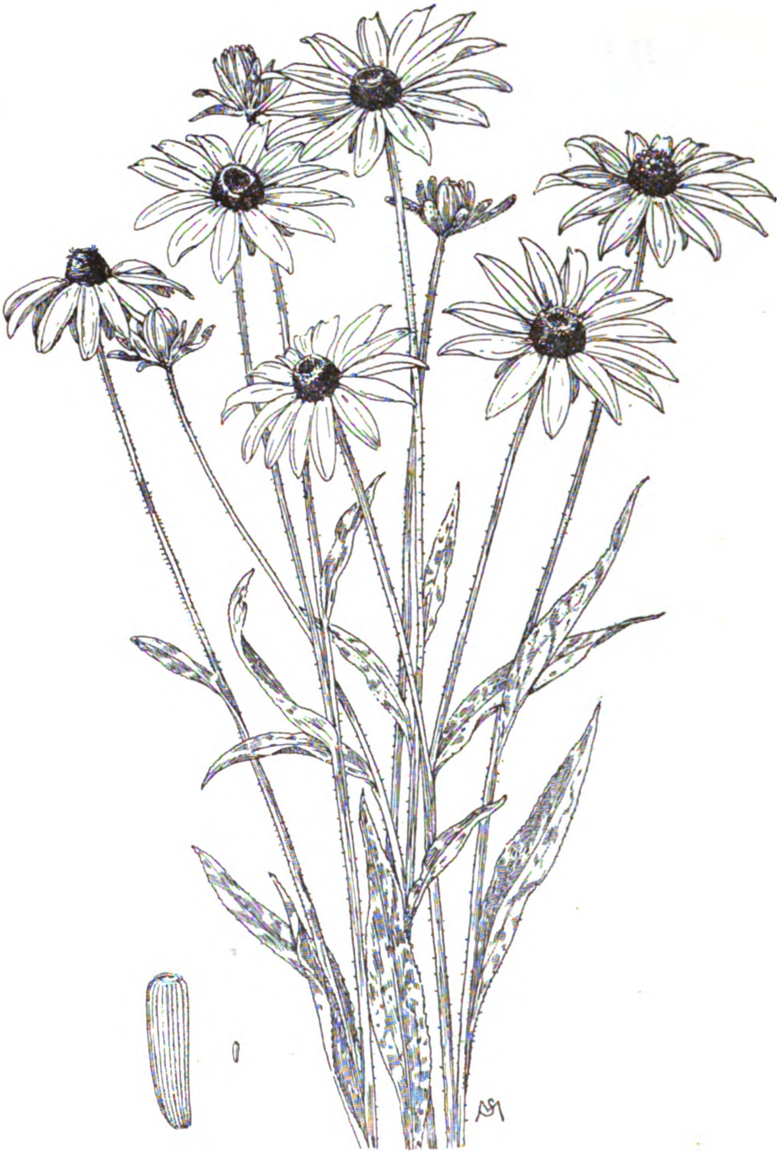


Fig. 236 (207).

Black-eyed Susan. Yellow Daisy. *Rudbeckia hirta* L. A very rough, bristly, hairy, erect, biennial, 30-80 cm. high; each stem bearing a single head; leaves narrow, 3-5-nerved; ray flowers orange yellow, often darker at the base, center of the head dark purple, very rarely green. Dry soil, a native in the state; introduced east mixed with clover seeds.

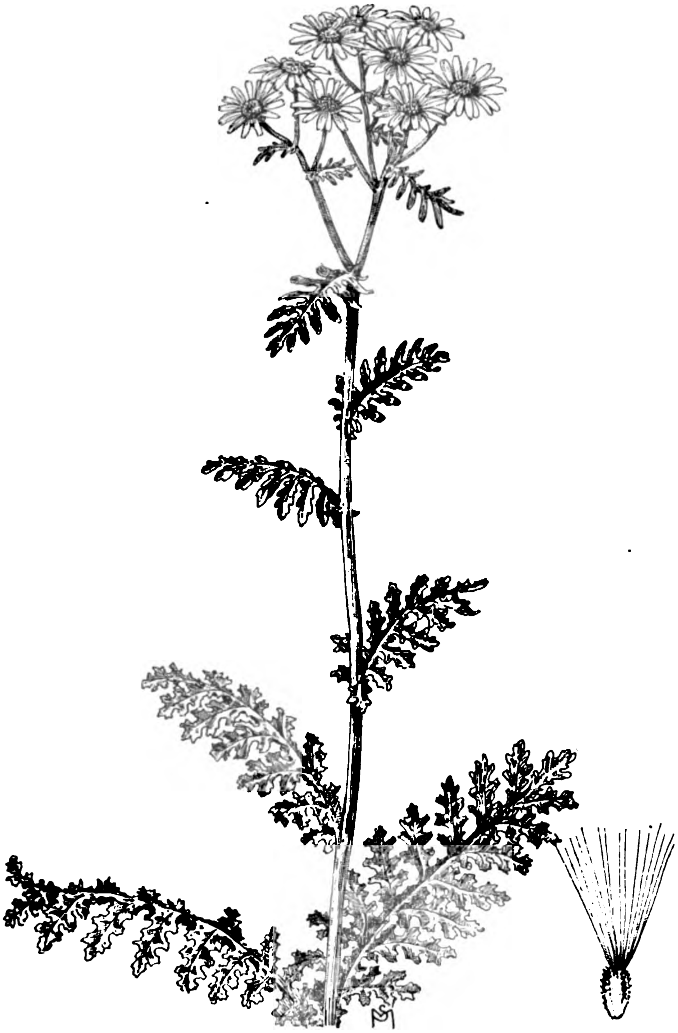


Fig. 237.

Stinking Willie. Staggerwort. *Senecio Jacobaea* L. Perennial, stout, often woolly, very leafy, 60-120 cm. high, having short, thick rootstocks; leaves usually 2-3-times lobed, 2-15 cm. long; heads very numerous in large compact, flat-topped clusters: flowers golden-yellow. Introduced from Europe and found in Maine, Nova Scotia, Quebec, locally in Ontario. Not yet known to occur in Michigan. The plant is very poisonous, causing a fatal disease of the liver in cattle. It is not injurious to sheep.

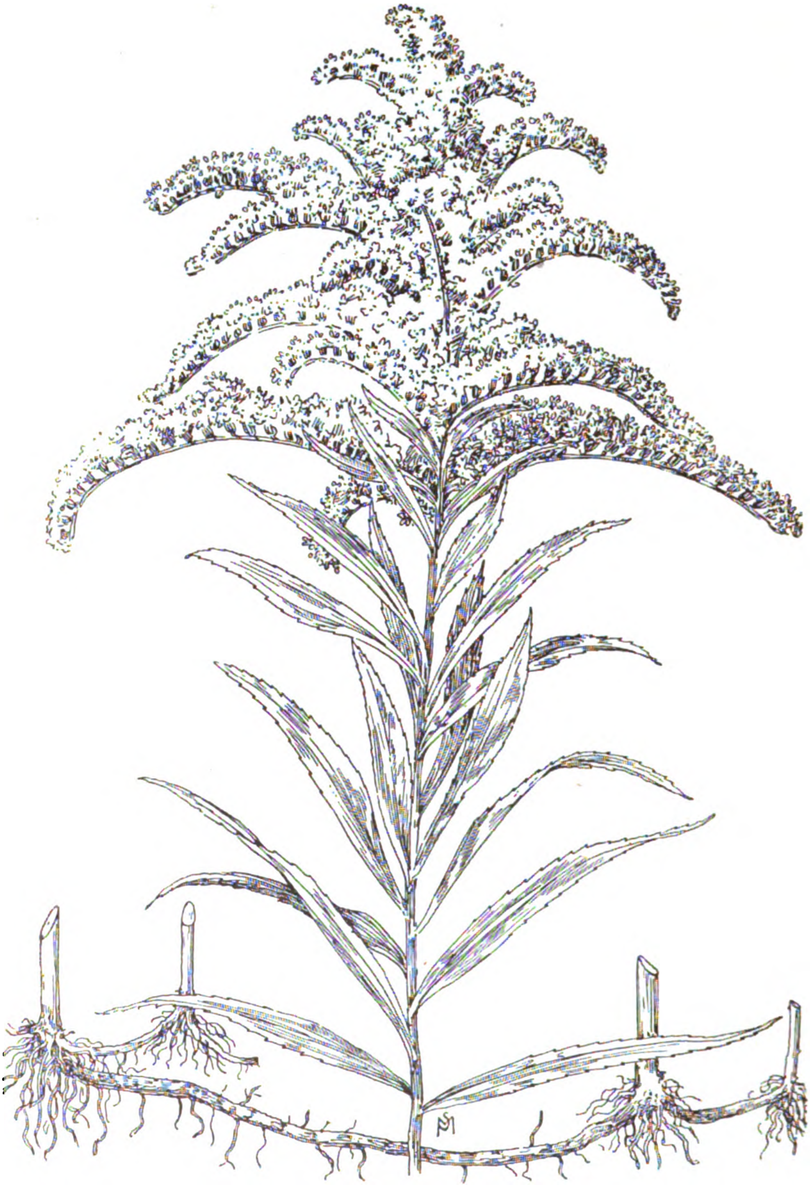


Fig. 238.

Canada Golden-rod. *Solidago canadensis* L. Stem erect, stout, usually minutely pubescent, 60-150 cm. high; leaves narrow, three-nerved, 6-13 cm. long; heads small, crowded in recurved one-sided racemes. A native plant; very common in low land, where it spreads rapidly by rootstocks. Several other species are just as bad when they are as abundant.

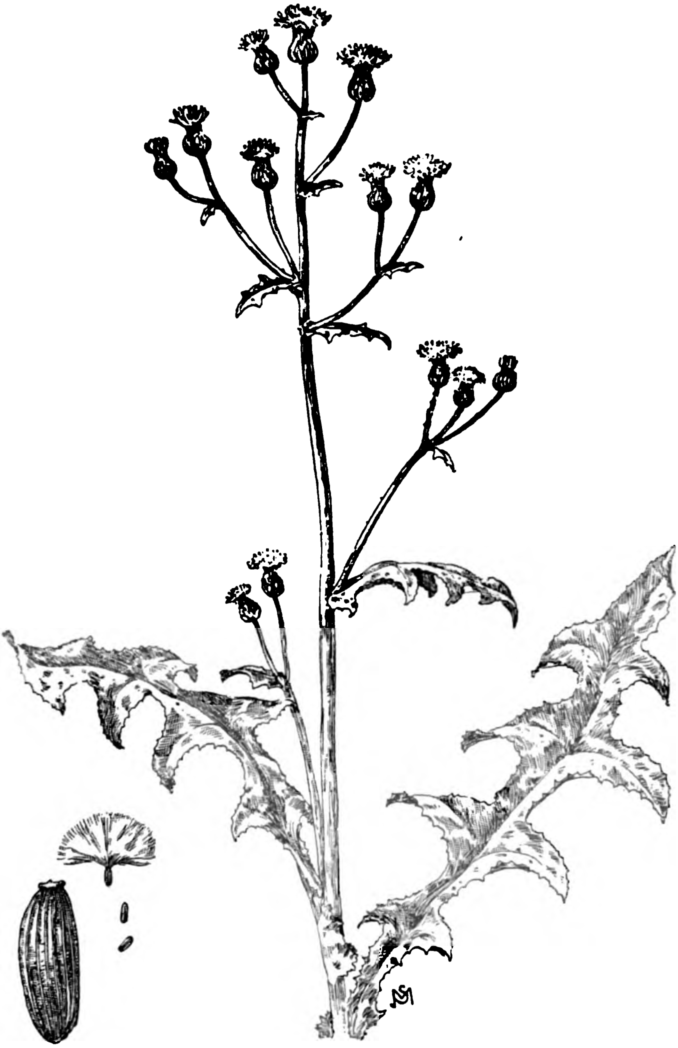


Fig. 239 (208).

Field Sow Thistle. *Sonchus arvensis* L. Chiefly smooth, a coarse weed, juice milky, 60-120 cm. high; spreading by rootstocks; leaves variously lobed, spiny-toothed; flowers yellow. Introduced from Europe and a rampant weed.

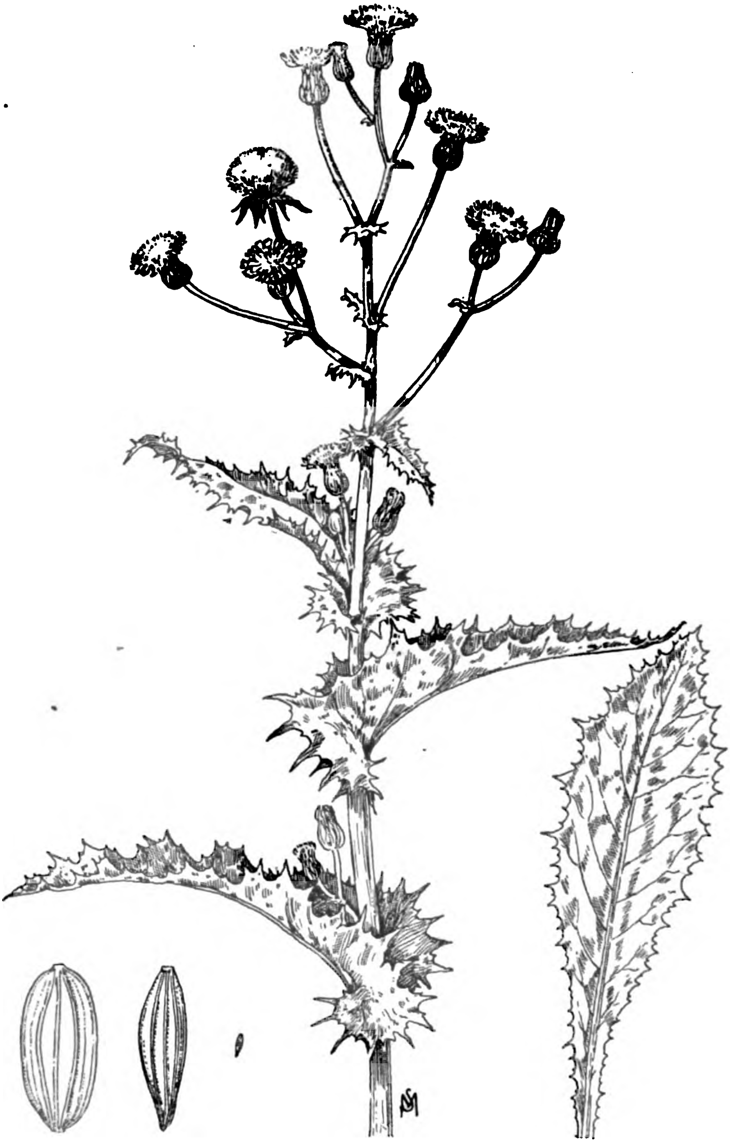


Fig. 240 (209).

Spiny-leaved Sow Thistle. *Sonchus asper* (L.) Hill. Chiefly smooth, except margins of leaves, juice milky, 30-90 cm. high; perennial; spreading by rootstocks and seeds; leaves prickly to the touch, not true of the other species; flowers pale yellow. Introduced from Europe.

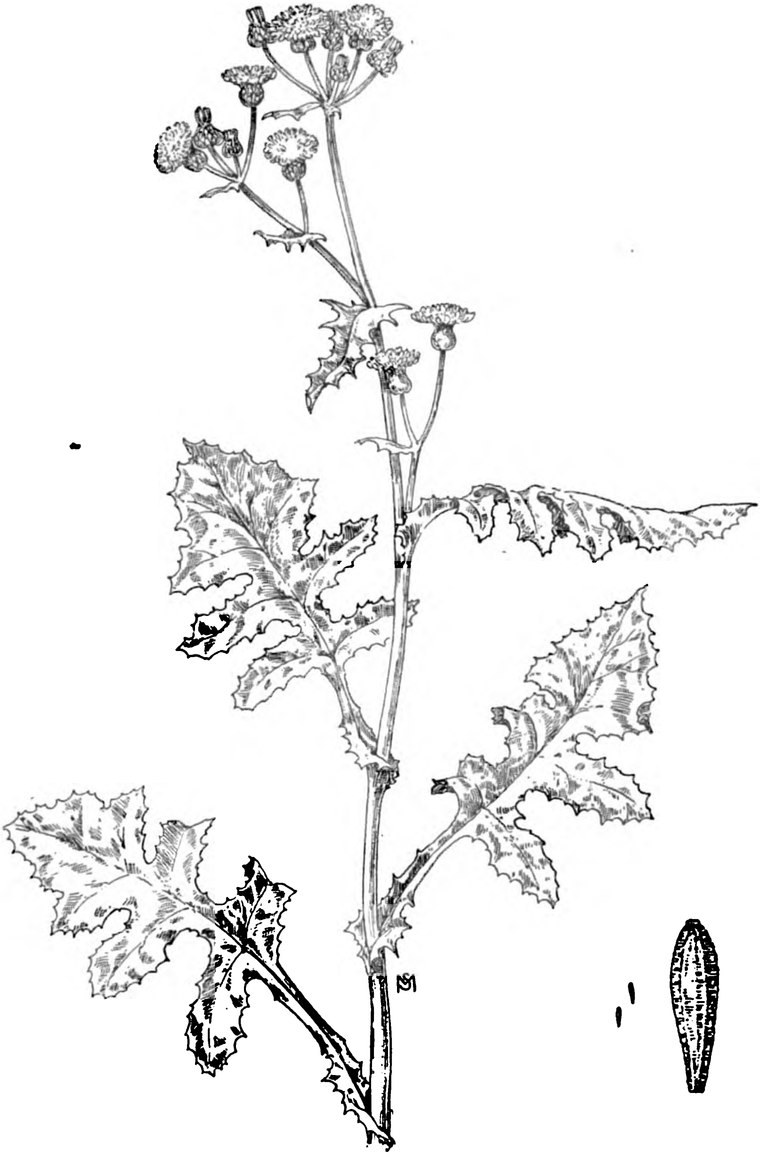


Fig. 241 (210).

Common Sow Thistle. *Sonchus oleraceus* L. Annual, erect, branching, leafy below; juice milky, 30-180 cm. high; leaves soft-spiny, toothed; flowers pale yellow.

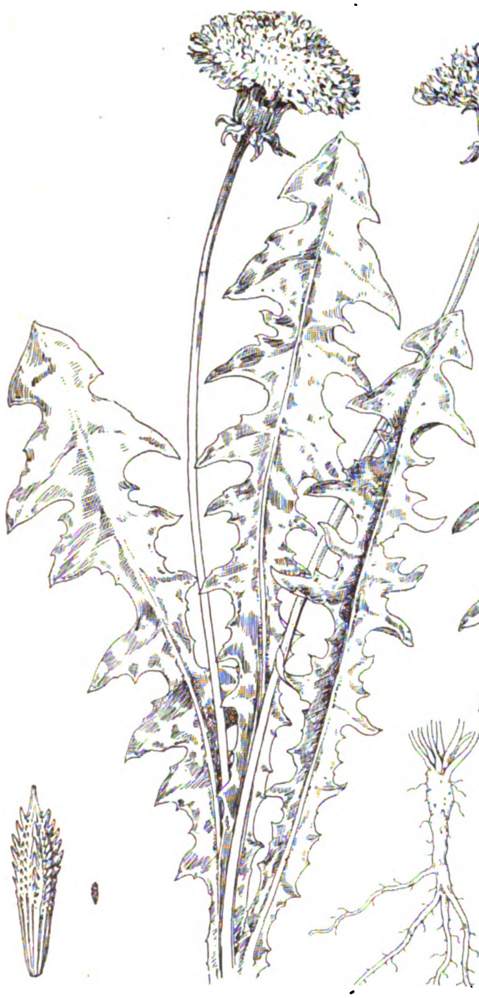


Fig. 242.

Common Dandelion. *Taraxacum officinale* Weber. (*Taraxacum Taraxacum* (L.) Karst.) Leaves, very variable, coarsely lobed and toothed; heads large (3-5 cm. broad), orange-yellow. See account of the following species.

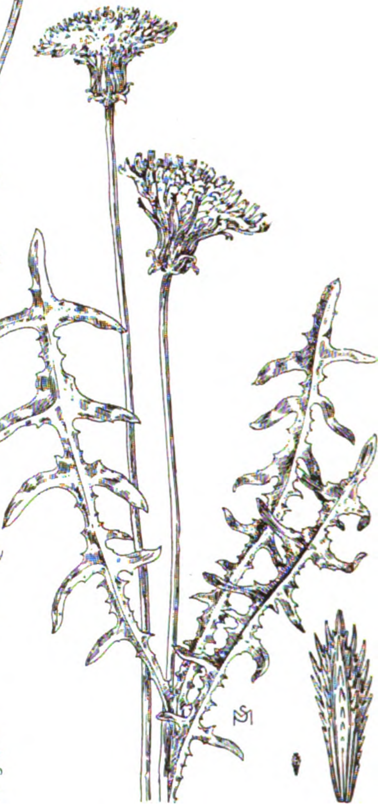


Fig. 243 (211).

Red-seeded Dandelion. *Taraxacum erythrospermum* Andrz. Leaves, small, deeply lobed, segments narrow, juice milky; compared with the next species, heads smaller, 2-3 cm. broad, sulphur yellow, the inner bracts with horn-shaped appendages; achenes smaller; bright red or red-brown, sharply prickled above.

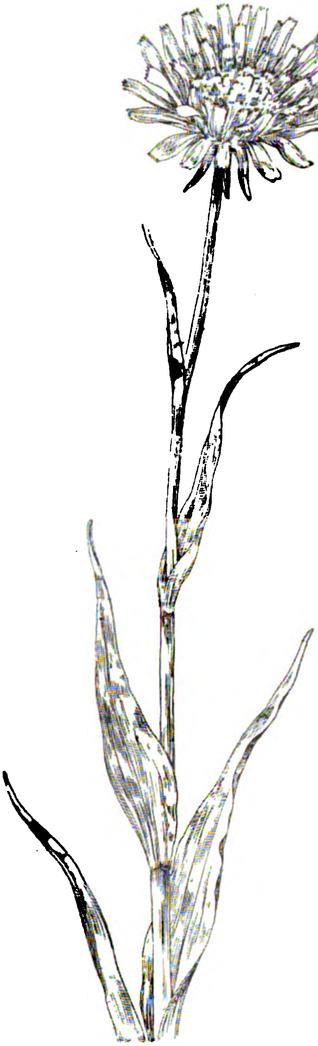


Fig. 244 (213).

Meadow Salsify. Yellow Goat's Beard. *Tragopogon pratensis* L. Very similar to the following species; leaves broader at the base; flowers yellow.

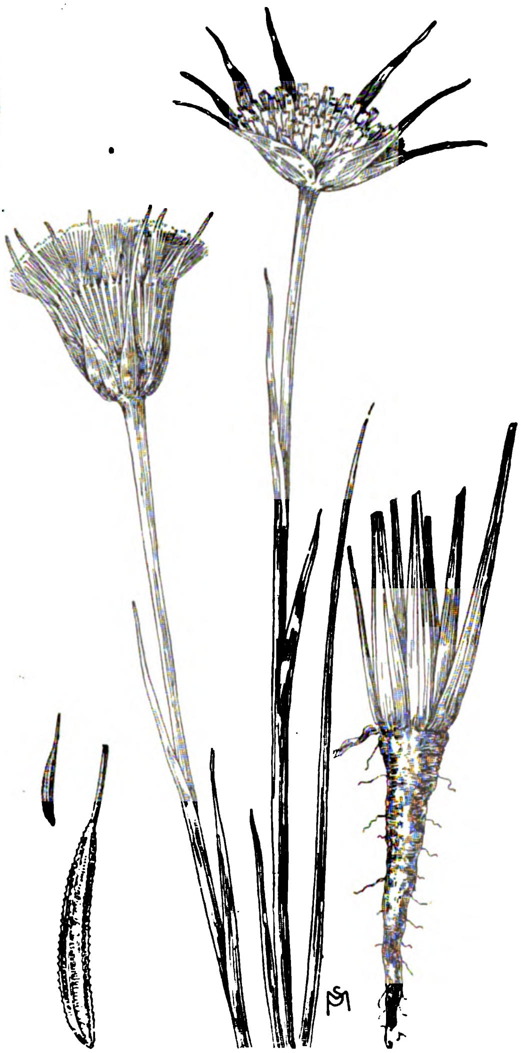


Fig. 245 (213.)

Salsify. Oyster-plant. *Tragopogon porrifolius* L. A stout, smooth, biennial, 45-90 cm. high, juice milky; leaves long and very narrow; flowers purple, showy.

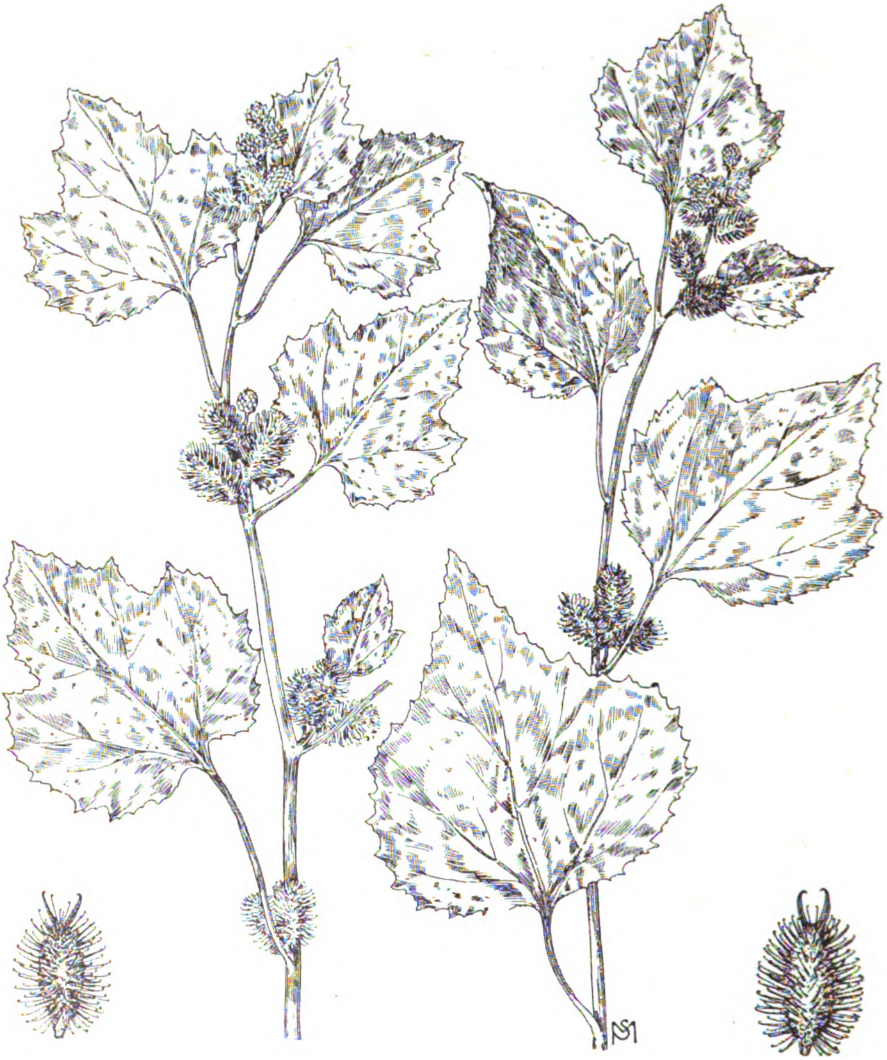


Fig. 246 (214).

American Cocklebur. *Xanthium canadensis* **Mill.** A coarse, erect annual, 30-120 cm. high; leaves broad, usually three-lobed; burs nearly smooth, 14-17 mm. long, 5-8 mm. in diameter, beaks slightly curved, prickles scattered, slender, hooked.

Fig. 247.

Common Cocklebur. *Xanthium commune* Britton. Much like *H. canadense* beaks of bur incurved, prickles numerous, crowded, 3-6 mm. long, hairy, as is also the body.

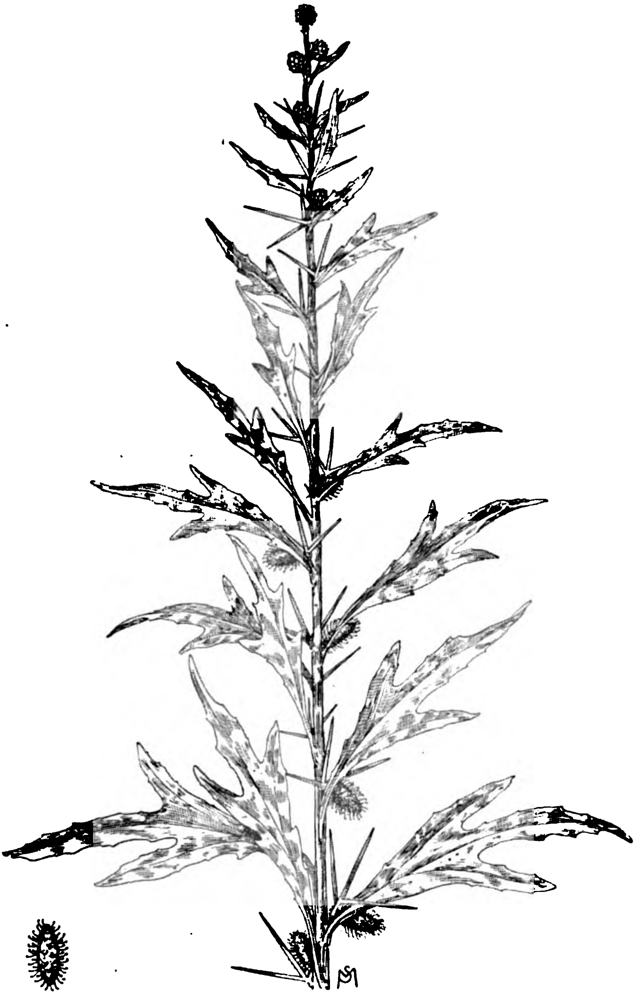


Fig. 248 (215).

Spiny Clotbur. *Xanthium spinosum* L. Stems mostly pubescent much branched, 30-90 cm. high; leaves narrow and at the base of each a three-pronged, yellow spine. The drawing is a trifle stiff, and straight for nature.

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Ac-cum-bent, leaning or lyging upon, applied to cotyledons when the caulicle (radicle) is folded against their contiguous edges.
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c. m. centimeter, see rule lines on last page.
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Decurrent, (leaf), extending down the stem below the insertion.
Deltoid, shaped like Greek letter delta, triangular.
Dentate, having broad acute marginal teeth which are usually directed outward.
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Floret, a single flower of a head or cluster, especially in Compositae.

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Fungi, produced by a fungus; pertaining to a fungus or to fungi, as a fungus disease. The substantive form fungus is also used as an adjective.

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Glaucous, covered with a whitish bloom as the leaves of cabbage, grape or plum.

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Gramineae, the scientific name for the grass family.

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Hastate, like the head of a halberd, applied to leaves which have a spreading lobe on each side of the base.

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Hirsute, clothed with rather numerous long coarse hairs, harsher than pubescent and less harsh than hispid.

Hispid, bristly.

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Leaflet, one of the divisions or blades of a compound leaf, as seen in the leaf of a locust tree.
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Linear, very narrow with the margins parallel or nearly so.
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Loculus, the cavity of an ovary or anther.
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Lyrate, pinnatifid, with the lobes decreasing in size toward the base.
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m. m. millimeter, see ruled lines on last page.
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Nutlet, a small nut or nut-like seed or fruit as many achenia.
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Oblanceolate, lanceolate in form, but tapering toward the base more than toward the apex.
Oblong, longer than wide with nearly parallel sides; compare oval.
Obovate, a flat body broader toward the apex than the base; see ovate.
Obovoid, a solid body broader toward the apex than the base. See ovoid.
Obtuse, having end or apex blunt.
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Oval, about twice as long as broad with regular curved outlines, broadly elliptical.
Ovate, like a longitudinal section of an ordinary hen's egg, with the attachment if any at the broad end.
Ovoid, the shape of a hen's egg and attached, if at all, at the large end.
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Palea, Palet, the upper bract which with floral glume encloses the flower in grasses.
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Panicle, a branched or compound raceme; a cymose panicle has the main axis terminated by the oldest flower, its branches terminated by the next oldest.
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Parasite, a plant which grows upon or within another living body, from which it derives a part or whole of its nourishment; compare saprophyte.
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Pellucid, translucent.

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Petiole, the stem of a leaf.	
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Pinnatifid, pinnately veined with marginal divisions reaching about half way to the mid-rib.	
Placenta, a part of the ovary to which the ovules or seeds are attached.	
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Root, the descending axis which is destitute of leaves or nodes.

Root stock, rizome, a stem usually subterranean and more or less thickened, producing young branches.

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Runner, a prostrate branch which roots and forms new plants at intervals, as the strawberry.

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Serrulate, having minute antrorse teeth on the margin. See Serrate.

Sessile, having no stem, as a leaf without a petiole or a flower without a pedicel.

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Spikelet, a small or secondary spike as found in grasses.
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Tubercle, a swollen part or a root due to bacteria. Usually applies to such as possess the power to fix nitrogen; a little tuber.
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Twining, ascending or coiling the stem in a spiral manner around a support; voluble.
Umbel, an inflorescence in which there is one flower to a pedicel, and these are all of nearly equal length and all start from nearly the same place at the apex of the stem.
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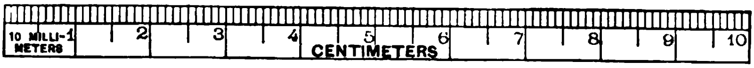

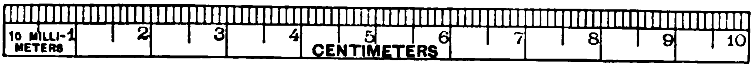

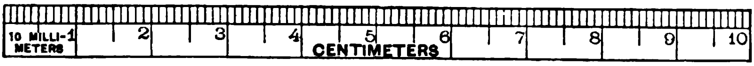

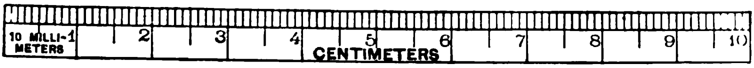

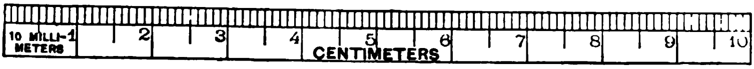

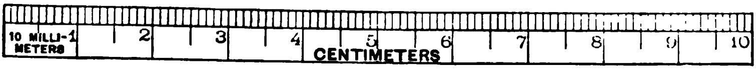

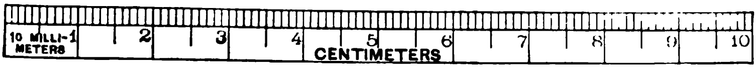

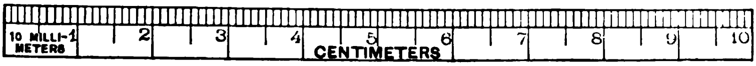

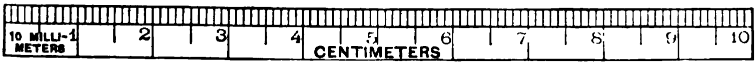

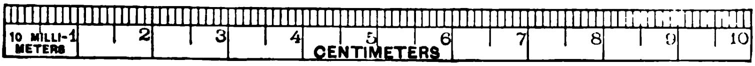

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FARM CROPS DEPARTMENT

WHEAT IMPROVEMENT

BY

F. A. SPRAGG

EAST LANSING, MICHIGAN.
1912

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them.. Address all applications to the Director, East Lansing, Michigan.

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SUB-STATIONS

Chatham, Alger County, 760 acres deeded—R. G. Carr in charge.
Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded—Frank A. Wilkin in charge.

WHEAT IMPROVEMENT.

BY FRANK A. SPRAGG.

Michigan Wheat Conditions.

If one should walk into the average wheat field in Michigan just before harvest, he would find occasional heads of a large number of types of wheat. Some of these might perhaps have a white chaff, some a red chaff, some might be bearded and some beardless, and if a number of heads were shelled differences would also be found in the grain such as hard, soft, red, white, etc. The writer has counted as high as a dozen types of wheat in one field. This shows that the farmer is growing a mixture of at least that number of varieties.

As can be seen in Fig. 1, Michigan is not producing the quantity of wheat that she should, were all her farmers practicing proper methods of culture and growing the best variety for their soil and conditions.

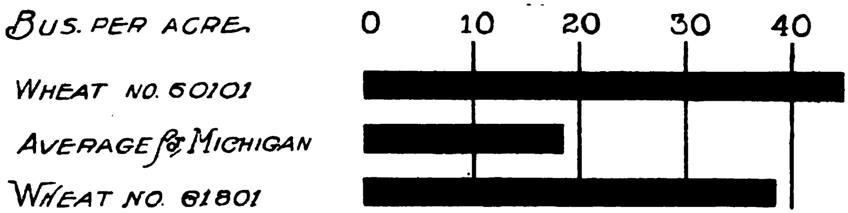

Fig. 1.—Showing the relative yields of two of the better varieties at the Michigan Experiment Station as compared with the average yield of the state.

Michigan is producing about half as much wheat per acre as she should. The average yield of wheat in Michigan for 1910 and 1911, as reported in the Yearbook of the Department of Agriculture, was 18 bushels per acre. Wheat No. 60101, which is a selection from the American Banner produced 42.8 bushels per acre and No. 61801, which is a selection from the Shepherd's Perfection, 39.3 bushels per acre as an average for the same two seasons. No doubt many of the low yields that cut down the state's average come from a class of careless farmers who continue to plant year by year any kind of wheat that they may happen to have. These farmers do not use the fanning mill to clean out the light chaffy grains and weed seeds. They do not select their seed at all and after a time they say that their variety of wheat has "run out." Instead, the facts are that the wheat has been mixed with so many almost worthless wheats as to lose its identity, while the original wheat if purified might really be a better variety for the particular conditions than originally.

ORIGIN OF THE COMMON VARIETIES OF WHEAT.

It may be interesting to give the origin of a few of the better known American wheats. The Fultz wheat was originated in 1862 by Abraham Fultz of Mifflin County, Pa. He picked a few stray beardless heads out of a field of Lancaster wheat, which is bearded. He planted the grains from the selected heads that year and continued in this way until he had a considerable field of the new variety. This wheat is now being grown with good success in most of the eastern and central states and in several foreign countries.

In 1865, Mr. Garrett Clawson of Seneca County, New York, selected some of the best heads out of his field, the seed of which he increased during the next few years and thereby originated the White Clawson wheat.

Throughout the spring wheat districts of the northwest, there are a large number of Fife wheats forming the basis of the great wheat and flour production of that district. All of these are said to have been originated from a selection by Mr. David Fife, of Otonabee township, Ontario. A friend of his in Glasgow, Scotland, had obtained a small quantity of wheat from a cargo direct from Dantzic, Germany. Mr. Fife received it shortly before planting his spring wheat. As it proved to be a winter variety he was able to grow only three heads but he continued planting this wheat and distributing the product until now the Fife wheat is known throughout the country.

In Michigan we find several varieties that still carry the names of the originators. Among these are Betterley, Goings, Shepherd's Perfection, Eaton, Jones Longberry and Dawson's Golden Chaff.

PURIFYING AND TESTING VARIETIES.

At the Michigan Experiment Station thousands of individual plant selections are made. The seeds are at first planted so that it is absolutely known that each selection grew from a single seed. The best of these selections are planted in separate rows the next year. Here some of the undesirable lots are discarded before harvest. The remainder of the rows are threshed with that kind of care that allows not a single seed to get over into another lot.

The higher yielding of these wheats are planted in larger plots and as soon as possible they are planted in variety series. The plots in a variety series are usually one drill width (11 hoes) and long enough to make a one-twentieth acre plot. These long and narrow plots are placed side by side on as uniform land as is available. A three-foot path extends between each two adjacent plots. The first and every fifth plot thereafter is planted with the same variety as a check on the variations in the soil. The remaining plots are planted to different varieties. By this means the relative yielding power of these pure strains is found. This work is repeated each year. The average of three or more years' results should give a fair comparison of the several varieties. The less promising varieties are discarded as soon as they are proven to be inferior. The aim in this work is to save the best varieties each year and test them out in comparison with new varieties and finally to develop better varieties for the benefit of the Michigan farmer. Seed of the best of these varieties is being sent out each year to representative farmers who will keep the seed pure and sell seed to their neighbors. Through these cooperators the general farmer may expect finally to receive benefit from these pedigreed high producing wheats.

Thus the Experiment Station takes the ordinary commercial mixtures (called varieties) and if after some preliminary testing they are considered promising they are separated into several pure strains, each descending from single plants, and these are tested separately in the variety series. A variety that goes out to the farmer is not an original variety but the highest yielding pure strain found in one of them.

However, the yielding quality is not the only thing to be considered. The miller demands good milling wheats and the baker has a right to have good flour from which to make his bread. Thus a variety cannot be recommended simply because it is a high yielder but it must also be a good bread making wheat. The Experiment Station is now making milling and baking tests on the higher yielding wheats.

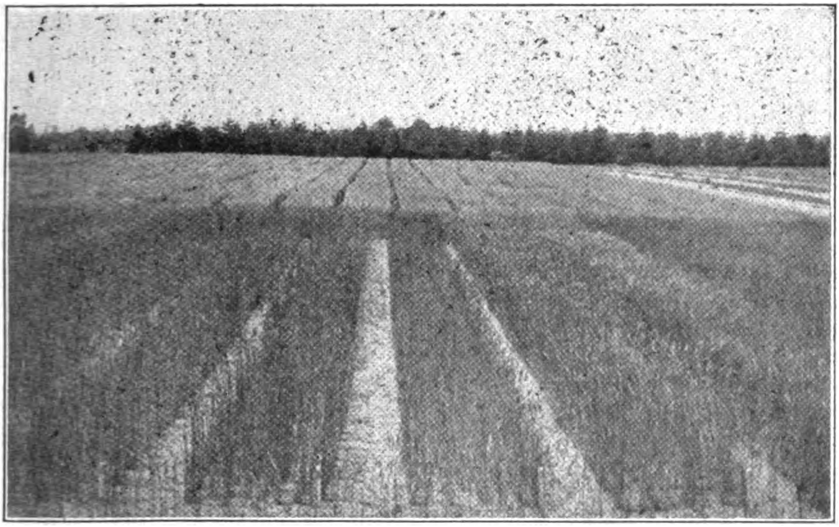

Fig. 2.—Series of 1/100 acre wheat plots in foreground, and 1/20 acre oat series in background. Mostly from individual plants of 1906. Crop of 1909.

Finally the farmer must study the adaptability of new wheats to his conditions. As a rule the farmer should avoid sending off great distances for seed wheat unless it be for experimental purposes. The Experiment Stations generally find that varieties from other countries must be grown for two or three years in their new home before the yield can be relied upon. Even grain that comes from other states changes both in quality and yield and it is probable that grain changed from one kind of soil to another in the same neighborhood does not do as well the first year after the change as it would have done under its home conditions. The farmer who has been awake to his possibilities in obtaining the best variety for his farm and who has selected that seed carefully on his own soil has undoubtedly a much better variety for his own conditions than can ordinarily be obtained outside. A few years ago the Minnesota and

North Dakota Experiment Stations exchanged seed wheat of the same variety. It was a pure strain that had come originally from Minnesota. Each Experiment Station planted the home grown seed in a plot alongside of that obtained from the adjoining state. In each case the plot from the home grown seed produced the more. The experiment was repeated with the same results. On the average the home grown seed produced 2.5 bushels more per acre than the imported seed. This simply brings out the point that it is unsafe to get seed of a new variety of wheat for planting a general acreage unless the wheat has been tried under the same or similar conditions. It does not mean that wheats from the Experiment Stations or other sources should not be tried. A new variety from reliable sources may promise considerable in the way of increased yields, but should be used for the first time in a moderate way and in comparison with the home varieties.

WHAT FARMERS CAN DO TO IMPROVE THEIR WHEATS.

Farmers can keep their wheats from "running out." It is very important to keep a variety pure. A wheat said to be "run out" is really so badly mixed with low grade and poor yielding wheats (if not also weed seeds) as to lose its identity. Light wheat and weed seeds should always be cleaned out with a good fanning mill. Always remember that "like begets like," and a man can hope to harvest only what he sows.

Much of the work at the Experiment Station includes the isolation of pure strains and the testing of these to give the farmer only the best. The farmer can cooperate by keeping the wheats pure. The threshing machine brings grain from the neighboring fields and the first few sacks of grain threshed will be mixed with these other varieties. The farmer should always have his next year's seed in mind at threshing time. All he needs to do is to save his seed wheat after the machine has been running long enough to shake out all the foreign wheat. This wheat should then be stored separately for seed purposes.

If, however, a pure variety has been mixed, it can be purified with a little more work. Two or three hours should be spent just before the wheat is cut in gathering some of the best heads of the type of wheat that it is desired to raise. Half of a burlap sack full of such heads will give the farmer a good start. This sack should be hung up in a sheltered place, where it will have a free circulation of air and be away from the mice. When the heads are thoroughly dry, the wheat may be threshed by pounding the sack with a stick. Then after looking the fanning mill over to see that no other wheat is caught in the screens, run this small lot of wheat through. This pure wheat should be sown in a plot by itself being careful to keep it separate at threshing time the following season. It would pay to flail it out to make sure that it is not mixed with other wheats. This will provide enough seed to sow a good sized plot which can be threshed the next season with the ordinary thresher but the first two or three sacks of it must be set aside and the seed wheat saved after that.

WINTER KILLING.

The winters of 1909-1910 and 1911-1912 have enabled the Experiment Station to observe the wheats from the standpoint of endurance to cold and ice sheets, the past winter presenting especially favorable conditions

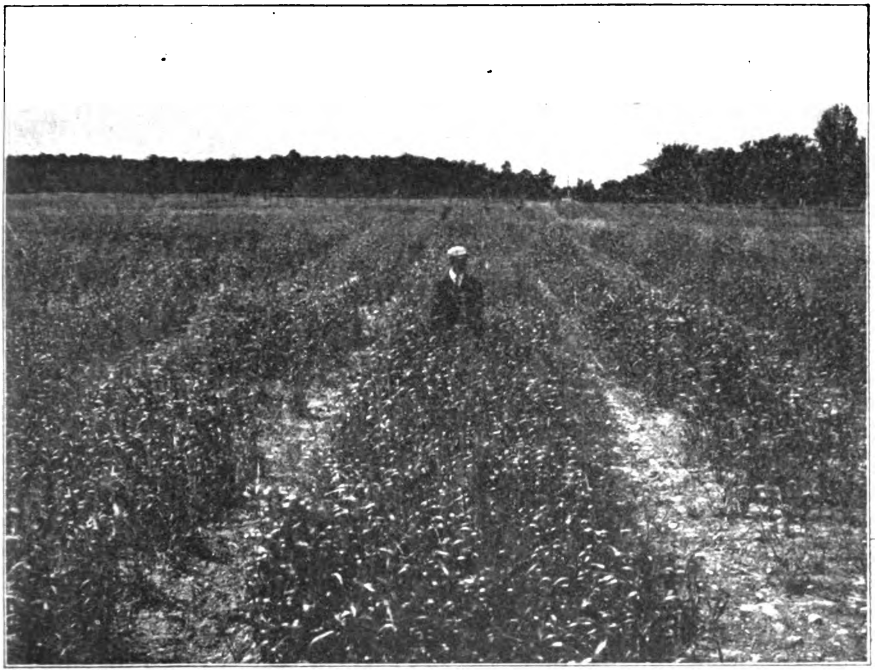

Fig. 3.—Portion of the 1912 wheat variety series showing an especially hardy plot.

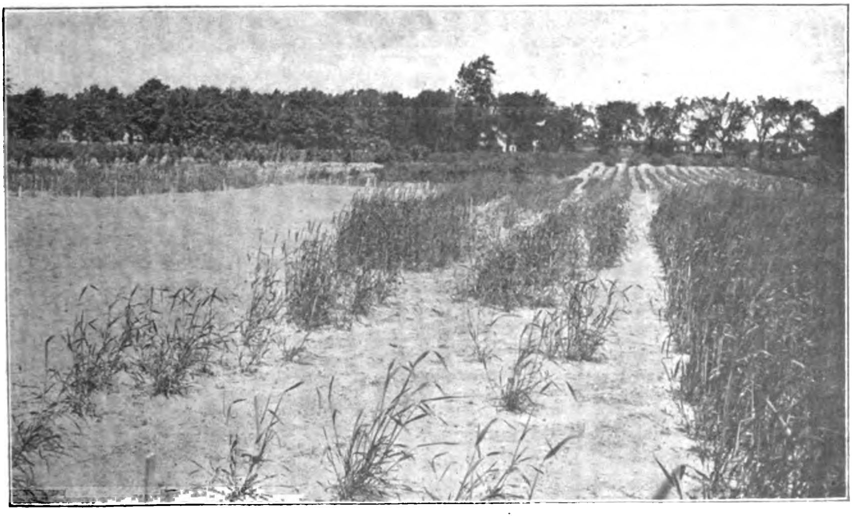

Fig. 4.—The 1912 wheat nursery showing relative resistance to cold, among varieties.

for the comparison of the hardiness of the different varieties. In the variety series, where some varieties were almost entirely killed, others have survived fairly well. Nine varieties stand out so markedly as to attract attention and ten others are easily judged as superior to the check (Shepherd's Perfection) in power to resist cold.

In Fig. 3, is shown a portion of the 1912 variety series. The plots are long and narrow, as is also shown in Fig. 1. In the center of the cut may be seen Bearded Rock (97003) with a stand of 74.3%, spring of 1912. On the right is Shepherd's Perfection (61801) used as a check in the variety series. This variety had an average of 21% stand this spring. On the left is Bearded Mealy, with a stand of 19.4%.

In Fig. 4, is shown the nursery where new wheats are selected. The seeds are planted separately in hills 5 by 5 inches apart, that each plant may have the same chance and that the best plants may be found and selected as mothers of new strains. The plots are five feet wide and long enough to take care of 200 or 300 seeds. Each stake represents a plot. In the fall of 1911, a large number of foreign (Australian) varieties were planted here. This portion is shown to the left of the cut. These Australian wheats grew nicely last fall but were entirely winter killed. At the right may be seen some varieties of wheat that stood the winter in good condition. In the center of the cut also may be seen a variety (plot) that is a good stand. Many of the other varieties have been almost entirely winter killed. These are mostly varieties that farmers are growing in different parts of Michigan but had never been planted at the College before. A few of these varieties, however, came from other states. The effect of a hard winter like 1911-1912 is clearly shown.

Table 1, gives a comparison of some of the best wheats as to the resistance to cold and ice during the winter of 1911-1912. Some new wheats are included that are not mentioned in other tables of this bulletin because of their great resistance to unfavorable winter conditions.

TABLE I.

Selection or accession number.	Names of varieties.	Description of varieties.						
		Bearded or awnless.	Color of chaff.	Color and hardness of grain.	Percent.			
					Winter resistance.	Patent flour.	Gluten in the patent flour.	Bread score.
60602	Early Windsor	Awnless	Red	Pearl (W)	53.8	64.9	9.65	82
60101	American Banner	Awnless	Red	Pearl (W)	72.0	59.9	13.35	78
78605	Plymouth Rock	Awnless	Red	Pearl (W)	57.8	65.0	11.0	80
913302	Genesee Giant	Bearded	Red	Pearl (W)	34.7	53.4	12.85	90
61801	Shepherd's Perfection	Bearded	Red	Common Red	21.	56.2	13.65	92
95201	Shepherd's Perfection	Bearded	Red	Common Red	48.8	53 9	17.8	92
912402	From a cross	Bearded	White	Common Red	42.81	54.3	20.2	....
912703	Craig's Favorite	Awnless	White	Common Red	82.2	58.7	21.8	....
97003	Bearded Rock	Bearded	White	Common Red	74.32	......	....	....
61101	Hungarian	Bearded	White	Common Red	25.5	60.9	13.85	....
60201	Buda Pesth	Bearded	White	Soft Red	61.3	57.3	17.85	83
15	Berkley	Bearded	White	Hard Red	74.5	66.7	14.8	94
61302	Mealy	Awnless	White	Hard Red	23.8	70.0	15.6	83
913802	Harris	Bearded	White	Hard Red	75.2	61.	12.95	....
925306	Stoner's Miracle	Bearded	White	Hard Red	67.5	61.2	12.75	....

PRODUCTION OF NEW VARIETIES BY CROSSING.

Several wheats were crossed in 1906 at the Michigan Experiment Station. Two of the resulting new wheats are mentioned in Table I, under numbers 912402 and 912703, of which the latter appears to be promising.

During the past six years a large number of other varieties have been closely studied. Three varieties, (viz. Genesee Giant, Shepherd's Perfection and Berkley) have been picked out as superior bread makers. Seven varieties in Table I produce above 60% patent flour and are therefore, good milling wheats. In considering winter hardiness, we find a half dozen wheats that have withstood the severe conditions of the past winter and are still good stands. Great differences among the varieties are also found in the yields, stiffness of straw and other characteristics.

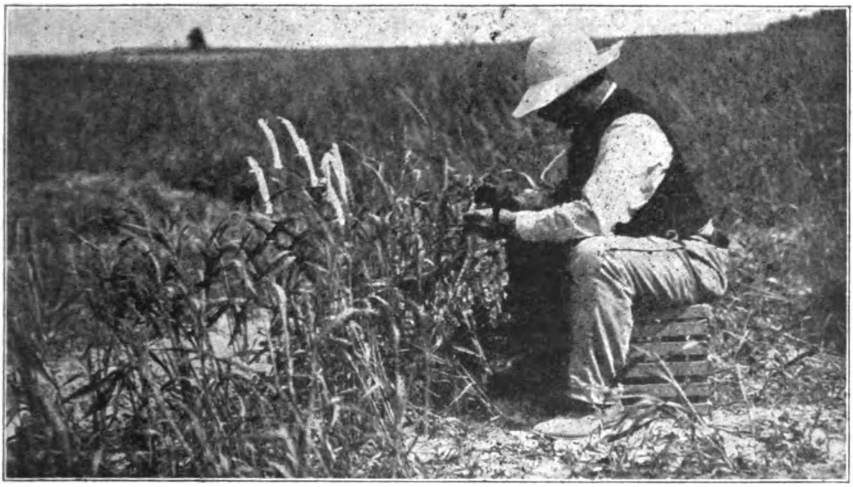

Fig. 5.—Crossing wheats.

The best variety should combine a number of good traits. It should produce well, the straw should be stiff enough so as not to lodge in rainy seasons and it should be a winter hardy variety, moreover, it should be a good miller and its patent flour should produce good bread. Unfortunately, none of the Station wheats combine all of these qualities, therefore, a number of crosses were made during June, 1912. The traits entering into the parentage of any cross should unite in every possible combination in the second year (1914) and from among these it is hoped to select strains possessing better combinations of characters.

Among our highest yielding wheats, American Banner, (60101) has been selected as also being among the best resisters of winter conditions. This variety has been crossed with the best bread makers mentioned above and also three other wheats (viz. No's 912703, 913802 and 925306) that are also hardy and appear to have superior quality.

Berkley is our best variety considering the combination of winter hardiness and high quality at the mill and in the oven. Its main defects are a weak straw and only a moderate yield. Besides American Banner, this wheat has been crossed with Early Windsor (60602), two strains of Shepherd's Perfection, (61801 and 95201), Plymouth Rock (78605) Genesee Giant, (913302), Bearded Rock (97003) Canadian Hybrid and Craig's Favorite (912703). These wheats all have stiffer straws than Berkley and include other desirable qualities.

Genesee Giant is our best bread maker among the pearl wheats. Besides the crosses with American Banner and Berkley, it has been crossed with Bearded Rock (97003), Harris (913802), Canadian Hybrid and Craig's Favorite (912703).

In all, twenty different crosses have been made during the month of June, making between 3,000 and 4,000 crossed flowers.

Fig. 5, shows the actual work of crossing in progress. First the flower must be emasculated, that is, the anthers containing the pollen or male element, must be removed and pollen for fertilizing the flowers is obtained from the other variety of the two wheats being crossed. The cut shows the application of pollen by means of a small brush to the emasculated flowers. The heads that are wrapped in white cloth are finished.

VARIETY TESTS.

During the past six years the Experiment Station has dealt with 126 varieties of wheat. These wheats have all been more or less mixed when they came to the Station, but the mixtures in many of them have been isolated and tested out alongside of the purified original sorts. There are, doubtless, many more varieties throughout the state that are promising for this breeding work and should be tested out in this way. However, many of Michigan's wheats are identical or nearly so, though known under different names. Again, a large number of varieties that are grown through the state are so low in milling quality as indicated by the softness of the grain, that it hardly seems worth while to add any more of them to the Station's list. When a farmer has a wheat that is harder than the average, and a good yielder on his farm, the Experiment Station would be glad to hear of it or receive a small sample as it may prove to excel others already obtained.

None of the softer white wheats have been listed in Table II, as they are considered too poor in milling and baking qualities to be longer continued in the work. In the column headed color and hardiness of grain, pearl stands for a white wheat, which has somewhat of a pearly appearance, is fairly hard, and as a rule is a good milling wheat. Red, stands for red wheats, which are equal to the pearl type in hardness. The soft red wheats are softer than the pearl. The hard red types compare fairly well with the western hard winter wheats. All types contain a small portion of yellow berry.

Of the 300 selections which the Station has grown in 1912, most of those not represented in Table II have been tested in the larger plots for only one year, or are being grown in the small selection plots as yet. It will also be noticed that half of the varieties that are listed are not being continued in 1912. An * indicates that the variety has been dropped. The reason for dropping these varieties has not been altogether the yield. The lowest yielders have been dropped. Then in the middle class, those of poor quality have been dropped out of the work to make room for the more promising.

TABLE II.

Selection or accession numbers.	Names of varieties.	Description and yield of varieties tested.							
		Bearded or awnless.	Color of chaff.	Color and Hardness of grain.	Per cent.		Yield in bushels per acre.		
					Loose smut.	Lodged plants.	1911.	Average 2 yrs. 1910-11.	Average 3 yrs. 1909-11.
60602	Early Windsor	Awnless	Red	Pearl	2	8	48.3	43.7	40.1
60101	American Banner	Awnless	Red	Pearl	4	8	45.8	42.8	......
60501	*Early Ontario	Awnless	White	Pearl	1	7	46.3	41.9	37.8
60401	*Dawson's Golden Chaff	Awnless	Red	Pearl	10	7	44.8	41.5	39.6
78605	Plymouth Rock	Awnless	Red	Pearl	1	6	38.0	40.0	......
8	Genesee Giant	Bearded	Red	Pearl	1	5	45.4	39.7	36.7
61801	Shepherd's Perfection	Bearded	Red	Red	1	9	45.9	39.3	39.2
61001	*Harvest Queen	Awnless	White	Pearl	1	4	40.7	38.1	......
78501	*Goings	Bearded	Red	Soft Red	20	15	44.4	37.7	......
61101	Hungarian	Bearded	Red	Red	0	6	39.7	37.1	......
61201	*Beechwood Hybrid	Awnless	Mixed	Red	3	3	41.5	36.9	33.5
60201	Buda Pesth	Bearded	White	Soft Red	4	10	46.8	36.8	38.2
7	*European	Bearded	White	Red	8	10	43.3	35.3	34.1
15	Berkley	Bearded	White	Hard Red	0	10	40.2	35.1	34.1
61302	Mealy	Awnless	White	Hard Red	3	4	42.4	34.9	33.6
60301	*Century	Awnless	White	Red	3	8	35.1	34.6	34.2
78508	*Awnless Goings	Awnless	Red	Red	1	14	32.0	33.7	......
28	*Turkey	Bearded	White	Hard Red	6	10	38.6	32.8	33.
40	*Silver Queen	Bearded	White	Red	2	14	32.1	31.4	31.6
41	*Babcock	Bearded	White	Red	3	9	35.1	31.2	31.7

*Dropped from work for 1912.

MILLING AND BAKING TESTS.

In the summer of 1910 the Station obtained an Allis-Chalmers Mill with three pairs of rolls. Two pairs are corrugated and one is smooth. The coarsely corrugated rolls are used to take care of the first three breaks. The finer corrugated rolls finish the bran and shorts. The smooth rolls are used to complete the process of pulverizing the flour. The mill is fitted with a full set of bolting cloths so as to separate the products as desired.

In the winter of 1910-1911, samples of all the Station's wheats, then in the variety series, were ground into flour, only one grade being made from each wheat. Baking tests were made by the Domestic Science Department of the Michigan Agricultural College, a loaf being made from each flour, using the same amount of flour, sugar, salt, and yeast in each case. The kneading, rising and baking were as uniform as possible and the breads differed only in the amount of water needed to make the dough of the right consistency. Two such tests were made at the College in the winter and the loaves exhibited at the State Corn Show. Two further tests were made at Columbus, Ohio, by the Domestic Science Department of the Ohio State University and these were exhibited at the National Corn Exposition. Other tests were made at the College early in June, 1911, and the bread was exhibited at the National Association of Operative Millers in Detroit.

From the data secured from these baking tests, it has been possible to eliminate six of the varieties of only medium yielding quality because of inferior baking qualities.

TABLE III.

Results of Baking Tests on 1910 Crop.

Selection or accession numbers.	Names of varieties.	Michigan Agricultural College.			Ohio State University.			Average.		
		Weight of loaf grams.	Volume cc.	Score.	Weight of loaf grams.	Volume cc.	Score.	Weight of loaf grams.	Volume cc.	Score.
60602	Early Windsor	593	1873	84	592.6	2133	80	592.8	2003	82
60101	American Banner	589	1744	74	581.8	2020	83	585.4	1882	78
60501	*Early Ontario	598	1631	71	611.8	1796	62	604.9	1713	66
60401	*Dawson's Golden Chaff	578	1659	83	618.9	2096	65	598.4	1877	74
78605	Plymouth Rock	580	1688	82	597.1	2080	79	588.5	1884	80
8	Genesee Giant	582	1761	88	609.2	2285	92	595.6	2023	90
61801	Shepherd's Perfection	588	1654	91	587.2	2354	93	587.6	2004	92
61001	*Harvest Queen	588	1716	71	620.6	2180	75	604.3	1948	73
78501	*Goings	590	1706	85	621.4	2342	85	605.7	2024	85
61201	*Beechwood Hybrid	600	1716	69	611.0	2190	70	605.5	1953	69
60201	Buda Pesth	589	1829	80	603.9	2322	86	596.4	2075	83
7	*European	586	1698	84	591.9	2300	84	588 9	1999	84
15	Berkley	588	1934	93	639.5	2392	95	613.7	2163	94
61302	Mealy	576	1945	84	641.2	2350	83	608.6	2147	83
60301	*Century	576	1759	78	612.4	2449	75	594.2	2104	76
78508	*Awnless Goings	572	1826	82	609.1	2310	91	590.5	2068	86
28	*Turkey	567	1695	92	609.4	2284	91	588.2	1989	91
40	*Silver Queen	576	1815	73	591.0	2170	75	583.5	1992	74
41	*Babcock	579	1788	84	613.8	2265	84	596.4	2026	84

*Dropped from work in 1912.

The extremely low yielders which are to be found at the bottom of Table III were dropped because of their low yield in the field. Others were dropped for other reasons, for instance, the Goings (78501) lodges easily and usually has a fifth to a sixth of the plants effected with the loose smut. The European has a weak straw and is not a hardy winter variety. The remainder of the discarded varieties are below 75% on bread score.

It will be noticed that the baking tests at M. A. C. and O. S. U. agree closely in score. Genesee Giant (Ac. No. 8), Shepherd's Perfection (61801), and Berkley (Ac. No. 15), are the best bread producing wheats among the medium and good yielders in the field. Turkey (Ac. No. 28) might have fallen into this class had it not been such a low yielder. The Berkley (Ac. No. 15), however, is a wheat of similar type but better in every way.

MILLING TESTS OF WHEATS HARVESTED IN 1911.

In February, 1912, milling tests were made with the different strains of wheat grown in 1911. The wheats were first scoured to remove the dust particles and the small hairs on the ends of the grains. In each case a ten pound sample was taken after scouring. Then it was tempered with the amount of moisture considered necessary to toughen the bran.

It was allowed to stand in a closed dish until it was no longer wet to the touch. Just before grinding, the sample was weighed again to determine the weight of water added. The yield of patent flour varied from 43% to 70%. The poorer varieties in this respect are not listed in Table IV. Nevertheless the Table shows great differences in the milling qualities of the different types of wheat.

TABLE IV.

Results of milling tests on 1911 wheats.

Selection or accession number.	Names of varieties.	Percentage of Products.						
		Scoured grain.	Moisture added.	Feed.	Flour.			Loss.
					Break.	Patent.	Tailings.	
60602	Early Windsor	100	0.8	26.7	4.0	64.9	4.1	1.1
60101	American Banner	100	1.2	30.3	7.8	59.9	2.7	0.5
60401	*Dawson's Golden Chaff	100	0.4	31.2	3.7	60.9	4.0	0.6
78605	Plymouth Rock	100	0.9	25.5	2.4	65.0	6.9	1.1
8	Genesee Giant	100	1.4	35.2	2.3	59.8	3.3	0.8
61801	Shepherd's Perfection	100	1.7	32.4	6.6	56.2	5.6	0.9
78501	*Goings	100	1.4	30.3	9.6	56.4	4.2	0.9
61101	Hungarian	100	0.8	29.1	4.8	60.9	5.3	0.7
60201	Buda Pesth	100	0.8	36.3	3.8	57.3	2.9	0.5
7	*European	100	1.8	33.1	3.5	58.6	5.8	0.8
15	Berkley	100	1.6	26.3	2.2	66.7	5.8	0.6
61302	Mealy	100	2.3	23.9	4.4	70.0	3.2	0.8
60301	*Century	100	1.0	32.5	2.5	61.4	4.0	0.6
28	*Turkey	100	0.8	28.1	6.0	62.5	3.7	0.5

*Dropped from work in 1912. Half of those marked with an * Tables II and III are also omitted here.

TABLE V.

Relation of hardiness to milling quality.

Classes of Wheats.	No. of wheats tested.	Type.	Percentage of Products.						
			Flour.						
			Scoured grain.	Moisture added.	Feed.	Break.	Patent.	Tailings.	Loss.
Hard red wheats	16	HR..	100	1.5	26.1	4.2	66.4	4.2	.6
Good quality pearl	15	W...	100	0.9	29.8	4.0	62.1	4.2	.8
Ordinary red	24	R....	100	1.3	32.3	4.7	58.2	5.3	.8
Soft red wheat	6	SR...	100	1.1	32.6	6.7	56.9	4.3	.6

Each of the lines in Table V show the average of the milling tests on the type of wheat in question. These are arranged in the order of the production of patent flour. If the soft white wheats had been included, they doubtless would have produced the smallest average per cent of patent flour. The production of feed and also break flour deceased as the patent flour increased. These data indicate that the pearl wheats are better in milling qualities than the ordinary red wheats although the latter are considered to be better bread producers. The hard red class of wheats is the best of all in milling qualities. There are, however, great differences between the varieties even in the same class. The Mealy, for instance, is an odd variety in the hard red class of wheats. It is a low yielder in the field because it is easily attacked by insects. It shows an exceptional yield of patent flour at the mill but the flour is dark in color and produces a poor, dark colored bread.

TABLE VI.

Analyses of wheats harvested in 1911.

Selection or accession numbers.	Percentage of constitutents.						
	Scoured wheat.	Protein N X 5.7	Starches sugars and other carbohydrates.	Ether extract or fat.	Crude fiber.	Ash.	Moisture.
60602	100	10.94	73.27	2.57	2.50	1.74	8.98
60101	100	11.80	73.03	2.60	2.40	1.72	8.45
60401	100	12.43	71.44	2.76	2.90	1.86	8.61
78605	100	12.48	71.57	1.95	2.75	1.74	9.51
8	100	12.48	71.48	2.36	2.85	1.91	8.92
61801	100	13.22	71.22	2.45	2.57	1.95	8.59
78501	100	14.25	70.11	2.09	2.79	1.73	9.03
61301	100	12.88	71.50	2.35	2.36	1.92	8.99
60201	100	14.53	68.91	2.45	2.58	1.84	9.69
7	100	13.79	70.17	2.27	2.72	1.91	9.14
15	100	14.53	70.31	2.38	2.42	1.70	8.66
61302	100	13.40	70.32	2.50	2.78	1.80	9.20
60301	100	13.22	70.71	2.33	2.57	1,93	9.24
28	100	11.97	72.83	2.34	2.21	1.69	8.96

Table VI. shows the chemical analyses made on these wheats (Crop of 1911) by the Chemistry Division of the Experiment Station.

SUMMARY.

1. The wheats grown throughout the state include many varieties which are poorly adapted to the conditions under which they are grown as shown by the low yield, poor bread making qualities, lack of winter hardiness, tendency to lodge, etc.
2. Pure varieties have been originated at the Experiment Station from single plants, found, as mixtures in old varieties. These types may have been carried accidentally from other fields or may have been produced from accidental crossing.
3. At the Experiment Station hundreds of varieties or strains have been isolated and tested for yield, milling and baking qualities, hardiness, etc., with the idea of finding the best all round wheats for sending out to the farmers of the state.
4. Finding no existing variety with a high excellence in all the characteristics, the Experiment Station has attempted to produce better combinations of characters by means of crossing of the better types.
5. In order to make the immense amount of work done at the Experiment Station in the breeding of wheats of much practical value to the farmers of the state, these improved wheats must be thoroughly tested in the different sections to learn their adaptability to the different

conditions. Plans have been perfected for the testing of these wheats on the farm and to increase in the hands of the farmer those varieties that prove to be valuable.

6. The farmer can keep his wheat from "running out" by use of a fanning mill, by the proper care in threshing and by occasional selection of a few heads at harvest time to be planted in a seed plot.

7. A large number of the varieties may be classed as soft white and soft red wheats; they are apt to be yellow, yellow spotted or bleached in color.

8. The best varieties among the white wheats have a clear pearly appearance. The pearl wheats are apt to be good millers, usually better than the ordinary red wheats.

9. The ordinary red wheats usually produce better bread than the pearl wheats.

10. The best milling wheats and usually the best bread producers are found in the hard red wheats. These wheats, however, make only a medium yield per acre in this state.

11. The best resisters to the winter conditions of 1911-1912 are the American Banner, Craig's Favorite, Bearded Rock, Berkley, Harris, Stoner's Miracle, Gypsy, Ohio 5309, White Eldorado, Awnless Berkley and Canadian Hybred. The first is a pearl wheat, the next two are common red wheats and the next three are hard red wheats. The Gypsy and the Ohio 5309 are soft red wheats. The White Eldorado is a spotted pearl and the last two are high grade red wheats.

12. Among these better winter resisters, American Banner and Berkley are the only ones that have been tested long enough to report results. Some of the others may yet prove to be valuable wheats for Michigan. The American Banner is a high yielding wheat of medium good quality. It is the best white wheat that the Experiment Station can recommend to date. The Berkley is the best miller and best bread maker but has a weak straw and is only fair in yield.

13. The Shepherd's Perfection has been the Station's highest yielding red wheat and is also among the best in bread making qualities but it does not take a high rank in winter resistance. The winter conditions during the past winter have, however, been more severe than have been experienced since 1885 and it may be said in favor of this wheat that it has survived the winter in good condition during all the other seasons it has been tested. While an attempt will be made to combine the good qualities of this wheat with the winter resistance of some of the other wheats, this variety is the best all-round red wheat for general recommendation to the farmers thus far discovered by the Experiment Station.

BULLETIN 269 **SEPTEMBER, 1912**

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MICHIGAN
AGRICULTURAL COLLEGE
EXPERIMENT STATION

CHEMICAL DIVISION

FERTILIZER ANALYSES

BY

ANDREW J. PATTEN, WM. C. MARTI AND ARAO ITANO.

AGRICULTURAL COLLEGE, MICHIGAN.
1912

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, East Lansing, Michigan.

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Railroad and Express address, - - - - - - - Lansing, Mich.

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SUB-STATIONS.

Chatham, Alger County, 760 acres deeded—R. G. Carr in charge.
Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded—Frank A. Wilkin in charge.

FERTILIZER ANALYSES.

ANDREW J. PATTEN, WM. C. MARTI AND ARAO ITANO.

The inspection and analyses of the commercial fertilizers offered for sale in Michigan are made under authority of an act of the Legislature approved March 10, 1885. The full text of the law is again printed since many inquiries are continually received concerning it.

SECTION 1. *The People of the State of Michigan enact,* That any person or persons who shall sell or offer for sale in this State any commercial fertilizer, the retail price of which exceeds ten dollars per ton, shall affix on the outside of every package containing such fertilizer a plainly printed certificate, stating the number of net pounds therein; the name or trade mark under which such article is sold; the name of the manufacturer; the place of manufacture, and a chemical analysis, stating the percentage of nitrogen in an available form; of potash soluble in water and of phosphoric acid in available form (soluble or reverted) and the insoluble phosphoric acid.

SEC. 2. Before any commercial fertilizer is sold or offered for sale, the manufacturer, importer or party who causes it to be sold or offered for sale within this State, shall file with the secretary of the State Board of Agriculture a certified copy of the analysis and certificate referred to in section one, and shall also deposit with said secretary a sealed glass jar containing not less than two pounds of such fertilizer, with an affidavit that it is a fair sample of the article thus to be sold or offered for sale.

SEC. 3. The manufacturer, importer, or agent of any commercial fertilizer, the retail price of which exceeds ten dollars per ton as aforesaid, shall pay annually to the secretary of the State Board of Agriculture, on or before the first day of May, a license fee of twenty dollars for each and every brand of fertilizer he offers for sale in this State: Provided, That whenever the manufacturer or importer shall have paid this license fee his agents shall not be required to do so.

SEC. 4. All such analyses of commercial fertilizers required by this act shall be made under the direction of the State Board of Agriculture and paid for out of the funds arising from the license fees provided for in section three. At least one analysis of each fertilizer shall be made annually.

SEC. 5. The secretary of the State Board of Agriculture shall publish in his annual report a correct statement of all analyses made and certificates filed in his office; together with a statement of all moneys received for license fees, and expended for analysis. Any surplus from license fees remaining on hand at the close of the fiscal year shall be placed to the credit of the experimental fund of said board.

SEC. 6. Any person or persons who shall sell or offer for sale any commercial fertilizer in this State without first complying with the provisions of sections one, two, and three of this act, or who shall attach or cause to be attached to any such package or fertilizer an analysis stating that it contains a larger percentage of any one or more of the constituents or ingredients named in section one of this act than it really does contain shall, upon conviction thereof, be fined not less than one hundred dollars for the first offense, and not less than three hundred dollars for every subsequent offense, and the offender shall also be liable for damages sustained by the purchaser of such fertilizer on account of such misrepresentation.

SEC. 7. The State Board of Agriculture by any duly authorized agent is hereby authorized to select from any package of commercial fertilizer exposed for sale in this State, a quantity, not exceeding two pounds, for a sample, such sample to be used for the purposes of an official analysis and for comparison with the certificate filed with the secretary of the State Board of Agriculture and with the certificate affixed to the package on sale.

SEC. 8. All suits for the recovery of fines under the provisions of this act shall be brought under the direction of the State Board of Agriculture.

LICENSED BRANDS.

Twenty-seven manufacturers and fertilizer companies have licensed 267 distinct brands for sale in the State during the season of 1912. The brands appearing in the following tables of analyses, and no others, can be legally sold.

Parties manufacturing or importing fertilizers for their own use and not for sale are not affected by the restrictions of the law.

COLLECTION OF SAMPLES.

The sampling agents of the Station, during the months of April, May and June, drew 526 samples from dealers' stocks representing 232 different brands. The failure to get samples of 35 brands is due to the fact that many of them are sold only in the fall, then, too, a few companies sell direct to the consumer through the Grange and other organizations and consequently it is only by chance that samples of such goods are obtained. If persons ordering goods in this way wish to have them inspected they will protect themselves and at the same time confer a favor on this department by notifying us, and upon the arrival of the goods an inspector will be sent to draw samples.

It is the desire of this department to make the inspection as complete as possible, and any information to further this end from dealer or consumer will be greatly appreciated. In all cases of failure to find a brand on the market, the analysis was made on the manufacturer's sample as indicated in the tables of analyses.

RESULTS OF INSPECTION.

A study of the tables of analyses shows that, of the 298 samples analzyed, representing 267 brands, 27 (9%) are below guarantee* in one or more constituents. Ten (3.3%) are below guarantee in nitrogen, 6 (2%) are below guarantee in available phosphoric acid, 1 (0.4%) is below guarantee in total phosphoric acid and 13 (4%) are below guarantee in potash. Two (0.7%) are below guarantee in nitrogen and potash, 1 (0.3%) in potash and available phosphoric acid.

While there are, as stated above, 27 samples falling below guarantee in one or more constituents, there is, however, only 1 (0.3%) that is more than 75 cents per ton below its guaranteed commercial value. This is a very satisfactory showing.

SCHEDULE OF TRADE VALUES.

In accordance with the custom adopted and followed in previous years, the following schedule of prices for determining the commercial valuation of a fertilizer is published:

Nitrogen	17.8c	per pound
Potash soluble in water...........	4½c	" "
Available phosphoric acid	5c	" "
Total phosphoric acid in bone.....	4c	" "
Insoluble phosphoric acid in fertilizers containing nitrogen.......	2c	" "

In fertilizers containing no nitrogen no value is given to insoluble phosphoric acid. The valuation of a fertilizer is determined as follows: The percentage or pounds per hundred of each ingredient (nitrogen, available phosphoric acid, insoluble phosphoric acid and potash) is multiplied by 20, giving the number of pounds of each ingredient in a ton. These figures are then multiplied by their respective pound prices.

In the last column of the table of analyses headed "Valuation" is given the commercial valuation of the samples, as guaranteed and as found, based upon the prices quoted above.

In calculating the valuations we have assumed that the sources of the various ingredients have been the same in all cases, which of course is not true and also unfair to the manufacturer using only high grade materials, as it places the manufacturer who uses low grade goods on the same level. Consequently it should be clearly understood that the station valuation does not represent the proper retail cost of the fertilizer at the point of consumption. It does, however, represent the cash cost, at the larger fertilizer centers of the middle west, of an amount of nitrogen, available phosphoric acid and potash in unmixed, standard raw materials of good quality, corresponding to the amounts found in one ton of the fertilizer in question.

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*A shortage of more than 0.10 per cent of nitrogen of more than 0.20 per cent of available phosphoric or potash is considered below guarantee.

The difference between the selling price and the station valuation is represented by the cost of storing, grinding, bagging, hauling and freighting the goods, commissions to agents and dealers, bad debts, depreciation of machinery, interest on investment, etc. The difference between the selling price and station valuation should not exceed 35 or 40 per cent. The station valuations are useful to show whether a fertilizer is worth its guaranteed money value and purchasers will often find them of advantage in comparing the relative values of similar brands offered by different manufacturers. The commercial valuation of a fertilizer bears no relation to its agricultural value. The agricultural value is measured by the increased yield of crop due to its use.

The great difference in fertilizers from the commercial as well as from the agricultural standpoint lies in the quality of the materials supplying the nitrogen. The sources of phosphoric acid and potash, available for fertilizer use, are few and they are, fortunately, of good quality. On the other hand, the sources of nitrogen available for the fertilizer trade are many and of very variable quality. Since the nitrogen is much more costly than either the phosphoric acid or potash it will be readily seen that the quality of the nitrogen supplied in the mixed fertilizer becomes an important one.

If it were possible to detect the materials used in compounding a fertilizer it would then be a simple matter to determine its worth but the process of manufacture is such as to make the identity of the materials very difficult, if not impossible. Consequently, the only safe advice, at the present time, that can be given to guide one in purchasing, is to always buy high grade fertilizers, because in compounding such fertilizers only high grade materials can be used. On the other hand low grade materials are quite generally used in mixing low grade fertilizers.

A comparison of the cost of plant food in the high and low grade fertilizers was published in Bulletin 252, which was distinctly in favor of the high grade fertilizer.

Following are the names of the parties from whose stocks samples were drawn:

Adair—C. P. Lipke.

Addison—Louis & Vanile.

Adrian—J. C. Van Doren, J. E. Bennett, H. Wellintz.

Alma—J. M. Montigel.

Amadore—Wm. Anderson.

Applegate—Byron Kelly, Farmers Grain & Hay Co.

Ashley—A. M. Derry & Son, Rockefellow Grain Co.

Azalia—E. F. Cowper.

Bad Axe—S. H. Pangborn, Jacob Sparling. Slack Bros.

Bankers—Wm. Cole.

Battle Creek—Robert Binder Estate.

Bay City—F. C. Goodeyne, Mohr Hardware Co., Presley & Layer, Jenison Hardware Co., Bay City Hardware & Implement Co.

Bay Port—A. Morse.

Belleville—A. Jackson, Stephen Pearl.

Benton Harbor—Cutler & Downing, B. M. Nowlen & Co.

Birmingham—Smith Bros., H. B. Parks.

Blissfield—W. A. Worthey, J. A. Mominee, Joe Rouget, F. L. Ganum, W. J. Uckele.

Brown City—J. H. Linck.
Butternut—Butternut Bean & Grain Co.
Camden—Geo. L. Tanner.
Capac—Lang Bros., L. R. Glassford.
Carlton—L. J. Guiermann.
Charlotte—Hertell & Martin.
Clayton—E. H. Hutchins.
Clinton—W. D. Vantuyl.
Coldwater—A. J. Fiske, S. I. Treat & Son, E. Dunton.
Coloma—G. R. Brown, I. G. Leedy, Coloma Hardware Co.
Coopersville—Laug Bros.
Covert—J. R. Spealman.
Croswell—W. Quale, Croswell Elevator Co., Sandusky Grain Co.
Davison—E. G. Post, J. J. Berry, Hammond & Hathaway.
Dearborn—S. Baldwin Estate, Chas. A. Kendt.
Deckerville—J. C. Merriman, Cowan & Binkle.
Deerfield—Frank Timmins.
Detroit—Lohrman Seed Co.
Dowagiac—Belton & Burch.
Dundee—Michigan Milling Co., Dundee Mercantile Co., O. Silley.
Durand—Durand Implement Co.
East Saugatuck—Vos. Reinerd.
Eaton Rapids—Frank E. Ford.
Farmington—V. G. Lockwood.
Flint—J. P. Burroughs & Son.
Galien—Swank & Dempsey.
Grand Haven—Speidel & Swartz.
Grand Rapids—Wm. Groen & Son, Grand Rapids Glue Co., Brown Seed Co., Jones Seed Co.
Greenville—E. B. Slawson.
Hand—J. H. Lang.
Hartford—H. L. Gleason.
Hastings—Edmonds Bros.
Hillsdale—T. H. Eddy & Co.
Holland—Mulder & Co., Henry Siersma, H. W. Harrington, John Meeswesner.
Howell—A. F. Bennett.
Hudson—W. D. Rhead, Jack Dilton, Atherton & Garling.
Hudsonville—Fred Yonker, C. Spoolman, B. T. Hughes.
Hunters Creek—M. Caley.
Ida—J. E. Schnell, N. A. Weipert & Sons, Ida Hardware Co.
Imlay City—B. Churchill.
Inkster—Geo. C. Walker, McNutt & Moore.
Ithaca—I. N. Cowdry, G. J. Coleman & Son, Ithaca Roller Mills, S. J. McWilliams.
Jackson—James Boland & Co., Isbell Seed Co.
Kibbe—J. H. Myers & Son.
Kingsland—Walter Halifax.
Lake Odessa—Claude Carpenter.
Lakeview—Rossman Bros.
Lambs—Farmers Elevator Co.

Lansing—Young Bros & Daley, McKim & Longstreet, Dubois & Hughes, Briggs & Co.

Lapeer—Turnbull Elevator Co.

LaSalle—John S. Heck.

Lawton—C. Dunham.

Lenawee Junction—D. F. Rockwell.

Lenox—Farmers Elevator Co.

Leslie—Darling & Freeman.

Lulu—Miles Elwood.

Manchester—Lonier & Hoffer.

Mason—John Bullen, A. J. Leonard, R. A. Osborn, J. E. Taylor, Dan Sears.

Mayville—Phelps Bros., A. E. Hollenbeck.

Memphis—F. G. Coburn, Day & McCall.

Middleville—E. J. McNaughton.

Milan—A. G. Forsyth & Co.

Monroe—Geckle & Martin, Monroe Hardware Co.

Montgomery—George R. Pierce.

Mt. Clemens—Wolf Bros., Clark & Hall.

Muskegon—J. Stegink.

New Boston—R. E. Krause.

New Buffalo—Siegmund Bros.

Novi—W. E. Erwin.

Nunica—J. D. Pickett, E. W. Hass.

Petersburg—H. Logan & Son, C. N. Wadsworth, E. T. Thompson, J. West.

Pewamo—M. J. Simon, Jas. W. Steel.

Pigeon—E. Paul, Daepker Bros.

Plymouth—W. S. Burch, James Gates, J. D. McLaren, G. C. Ravilier.

Pontiac—E. Howland & Sons.

Port Huron—McMorran Milling Co.

Portland—A. C. Barnard.

Quincy—Wm. A. Lott, Geo. Snyder, J. N. Boyer.

Reading—A. L. Lane, Kellog & Young, Jackson & Field, W. M. Cahow.

Redford—C. A. Lasher, Westlake Bros.

Romeo—Bradley & Chubb, Romeo Milling & Elevator Co.

Romulus—Dick Mewsom.

Royal Oak—J. M. Lawson.

Ruth—J. F. Schroeder, Bad Axe Grain Co., S. G. Gentner.

Saginaw—H. W. Carr & Co., Jerome Bros.

St. Clair—Recor & Smith, John Mau.

St. Johns—John Wallace Sons Co.

St. Louis—William G. Gibbs, St. Louis Hardware Co.

Sebewaing—John Rummel, E. Grasmann, Myers Reidel & Co., J. C. Liken & Co., —— Krohn.

Swartz Creek—A. C. Goodyear.

Tecumseh—Clayton & Son, J. McIntyre.

Temperance—R. W. Brunt.

Ubly—Chas. Ewing, D. H. Pierce.

Union City—A. D. Marsh, E. Worten.

Vassar—Farmers Elevator Co.

Vermontville—E. F. Tubbs, C. C. Hallenbeck, Vermontville Lumber Co.

Verona Mills—Geo. H. Whitham.

Vriesland—T. W. VanHaitsma.

Wayne—E. H. Langworthy, Wayne Milling & Produce Co.

Washington—J. F. Dernberger, R. Teeter.

White Pigeon—G. D. Grossman.

Woodland—J. S. Reisinger.

Wyandotte—F. C. Koch, Fred Busch.

Ypsilanti—O. E. Thompson & Son, M. Dawson, J. A. Minnich, I. B. Lefurge.

Zeeland—Van Dyke & Co., Vanhoven & Vereeke Co., Nykamp Bros.

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Company, Detroit, Mich.		
3027	Banner Dissolved Bone	Detroit	Claimed Found
3346	Banner Bone With Potash	Manufacturer's sample	Claimed Found
3228	Beet Fertilizer	Vassar	Claimed Found
3028	Double 10 Fertilizer	Bankers	Claimed Found
3029	Fine Ground Bone	Detroit	Claimed Found
3030	High Grade Bone and Potash	Lenawee Jct	Claimed Found
3310	High Grade Garden and Vegetable Fertilizer	Belleville	Claimed Found
3033	Maine Potato Formula	Ypsilanti	Claimed Found
3034	M. & I. Special Manure	Reading	Claimed Found
3196	Michigan Bean Grower	Vassar	Claimed Found
3240	Michigan 10 per cent Potash	Eaton Rapids	Claimed Found
3037	Muriate of Potash	Detroit	Claimed Found
3038	Nitrate of Soda	Detroit	Claimed Found
3035	New York State Special	Montgomery	Claimed Found

1912, expressed in parts per one hundred.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
	38	3.40	34 34.60		$34 00 34 60
	20 22.67	3.73	24 26.30	4 4.44	23 60 26 67
1.23 1.40	11 12.55	2.82	9 9.73	2 2.30	15 98 17 91
	12 14.35	2.30	10 12.05	10 9.90	19 00 20 96
2.47 2.92	20 18.50				24 80 25 19
	12 13.25	1.87	10 11.38	5 5.40	14 50 16 24
1.65 1.80	10 10.60	0.35	8 10.25	5 5.15	19 17 21 44
1.65 1.88	10 10.68	1 30	8 9.38	10 11.67	23 67 27 10
2.47 2.72	10 11.55	1.82	8 9.73	6 6.47	23 00 25 97
1.65 1.68	10 10.60	1.55	8 9.05	3 3.01	17 37 18 36
0.82 0.98	7 6.90	0.70	5 6.20	10 10.19	17 72 19 14
				49 52.25	44 10 47 03
15 15.70					53 40 55 89
0.82 1.23	10 11.50	2.80	8 8.70	3 3.93	14 42 17 74

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—*Con.*		
3036	Special Pea and Truck Grower	Wayne	Claimed.... Found.....
3197	Bradley's Acid Posphate	Covert	Claimed.... Found.....
3263	Bradley's Alkaline Bone Potash	Amadore	Claimed.... Found.....
3198	Bradley's B. D. Sea Fowl Guano	Hudsonville	Claimed.... Found.....
3039	Bradley's Dissolved Bone and Potash	Monroe	Claimed.... Found.....
3173	Bradley's Niagara Phosphate	Ruth	Claimed.... Found.....
3200	Bradley's Soluble Dissolved Bone	Hudsonville	Claimed.... Found.....
3201	Bradley's Special Potash Fertilizer	Covert	Claimed.... Found.....
3241	Crocker's Ammoniated Wheat and Corn Phosphate	Farmington	Claimed.... Found.....
3040	Crocker's Dissolved Bone and Potash	Montgomery	Claimed.... Found.....
3041	Crocker's General Crop Phosphate	Lenawee Jct	Claimed.... Found.....
3042	Crocker's New Rival Ammoniated Superphosphate	Belleville	Claimed.... Found.....
3043	Crocker's Universal Grain Grower	Belleville	Claimed.... Found.....
3045	Homestead Bean Fertilizer	Quincy	Claimed.... Found.....
3311	Homestead Bean Fertilizer	Middleville	Claimed.... Found.....

1912, expressed in parts per one hundred.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
2.47 2.71	11 12.20	.... 1.77	9 10.43	2 2.50	$20 40 23 04
....	12 13.25	.... 2.80	10 10.45	....	10 00 10 45
....	12 13.90	.... 1.35	10 12.55	2 2.28	11 80 14 60
2.06 2.22	10 11.50	.... 1.62	8 9.88	1.50 1.74	17 49 20 00
1.03 1.08	10 11.93	.... 1.72	8 10.21	2 2.46	14 27 16 96
0.82 1.04	9 10.40	.... 1.62	7 8.78	1 1.46	11 62 14 44
....	16 18.50	.... 2.70	14 15.80	....	14 00 15 80
0.82 0.93	10 10.95	.... 1.67	8 9.28	3 3.39	14 42 16 31
2.06 2.22	10 10.75	.... 1.07	8 9.68	1.50 1.93	17 49 19 75
....	12 12.73	.... 2.12	10 10.61	2 2.45	11 80 12 82
0.82 1.15	9 10.35	.... 2.10	7 8.25	1 1.40	11 62 14 45
1.23 1.45	11 12.35	.... 2.15	9 10.20	2 2.42	15 98 18 40
0.82 1.01	10 11.45	.... 1.37	8 10.08	2 2.38	13 52 16 37
1.65 1.74	10 10.75	.... 1.00	8 9.75	3 2.97	17 37 19 02
1.65 2.12	10 11.25	.... 0.64	8 10.61	3 3.26	17 37 21 35

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—Con.		
3242	Homestead Best Potato Fertilizer.................	Union City...........	Claimed.... Found.....
3046	Homestead Bone Black Fertilizer..................	Middleville...........	Claimed.... Found.....
3047	Homestead High Grade Garden and Vegetable Fertilizer.	Hastings.............	Claimed.... Found.....
3032	Homestead High Potash Phosphate................	Woodland............	Claimed.... Found.....
3048	Homestead M. and I. Fertilizer....................	Middleville...........	Claimed.... Found.....
3277	Homestead Pea and Truck Fertilizer...............	Manufacturer's sample.	Claimed.... Found.....
3229	Homestead Special Beat Fertilizer.................	Pigeon...............	Claimed.... Found.....
3049	Homestead Sugar Beet Fertilizer..................	Royal Oak............	Claimed.... Found.....
3050	Homestead 10 per cent Potash Manure............	Hastings.............	Claimed.... Found.....
3051	Homestead Ten Ten Special Compound............	Reading..............	Claimed.... Found.....
3044	A-1 Potash Fertilizer.............................	Hastings.............	Claimed.... Found.....
3052	Red Line Complete Manure.......................	Redford..............	Claimed.... Found.....
3202	Red Line Phosphate..............................	Vriesland............	Claimed.... Found.....
3053	Red Line Phosphate With Potash..................	Woodland............	Claimed.... Found.....
3203	Wolverine Phosphate.............................	Holland..............	Claimed.... Found.....

1912, expressed in parts per one hundred.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.73	10 10.15	.... 0.92	8 9.23	10 11.14	$23 67 25 79
2.06 2.29	10 11.60	.... 2.87	8 8.73	1.50 1.95	17 49 19 80
1.65 1.80	10 10.55	.... 1.35	8 9.20	5 5.18	19 17 20 81
....	12 13.75	.... 1.95	10 11.80	5 5.36	14.50 16 62
2.47 2.54	10 11.55	.... 1.47	8 10.08	6 6.39	23 00 25 47
2.47 2.82	11 12.50	.... 1.48	9 11.02	2 2.63	20 40 24 02
1.65 1.84	10 10.90	.... 1.25	8 9.65	5 5.46	19 17 21 61
1.23 1.52	11 13.30	.... 2.62	9 10.74	2 2.24	15 98 19 23
0.82 1.00	7 7.80	.... 1.27	5 6.53	10 10.80	17 72 20 32
....	12 13.55	.... 2.85	10 10.70	10 10.14	19.00 19 83
0.82 1.02	10 11.20	.... 2.00	8 9.20	3 3.19	14 42 16 50
0.82 1.28	9 11.20	.... 2.17	7 9.03	1 1.30	11 62 15 63
....	16 17.25	.... 2.95	14 14.30	....	14 00 14 30
....	12 13.30	.... 2.40	10 10.90	2 2.07	11 80 12 76
....	12 12.95	.... 2.62	10 10.33	....	10 00 10 33

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co. —Con.		
3243	Niagara Dissolved Bone and Potash	Adair	Claimed Found
3174	Niagara Grain and Grass Grower	Romeo	Claimed Found
3244	Niagara Potato and Vegetable Fertilizer	La Salle	Claimed Found
3175	Niagara Wheat and Corn Producer	Washington	Claimed Found
3278	Horse Shoe Acidulated Bone and Potash	Manufacturer's sample	Claimed Found
3230	Horse Shoe Animal Bone Manure	Lapeer	Claimed Found
3054	Horse Shoe Bean Special	Blissfield	Claimed Found
3055	Horse Shoe Bone and Potash	Ida	Claimed Found
3056	Horse Shoe Corn and Wheat Grower	Adrian	Claimed Found
3057	Horse Shoe Garden City Superphosphate	Wayne	Claimed Found
3204	Horse Shoe Half Potash Fertilizer	Brown City	Claimed Found
3312	Horse Shoe Half Potash Fertilizer	Greenville	Claimed Found
3058	Horse Shoe High Grade Vegetable Fertilizer	Blissfield	Claimed Found
3059	Horse Shoe Maine Potato Fertilizer	Wayne	Claimed Found
3060	Horse Shoe Potash Manure	Adrian	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	12 12.70	.... 2.22	10 10.48	2 2.20	$11 80 12 46
0.82 0.97	9 10.35	.... 1.65	7 8.70	1 1.29	11 62 13 98
2.06 2.13	10 10.65	.... 1.10	8 9.55	3 3.47	18 83 20 69
1.23 1.40	11 13.00	.... 1.90	9 11.10	2 2.32	15 98 18 93
0.82 1.11	12 15.20	.... 3.17	10 12.03	1 1.30	14 62 18 42
0.82 0.95	9 12.70	.... 1.70	7 11.00	1 1.26	11 62 16 19
1.65 1.81	10 12.10	.... 2.75	8 9.35	3 3.90	17 37 20 40
....	12 13.30	.... 2.40	10 10.90	2 2.00	11 80 12 70
1.65 2.02	10 12.35	.... 2.32	8 10.03	2 2.31	16 47 20 23
2.06 2.32	10 12.35	.... 2.67	8 9.68	1.50 1.66	17 49 20 50
....	12 13.00	.... 1.30	10 11.70	10 9.12	19 00 19 91
....	12 12.95	.... 1.48	10 11.47	10 10.30	19 00 20 74
1.65 1.95	10 12.00	.... 2.25	8 9.75	5 5.26	19 17 22 32
1.65 1.91	10 11.35	.... 1.47	8 9.88	10 10.99	23 67 27 16
0.82 1.15	10 11.43	.... 1.75	8 9.68	3 3.13	14 42 17 29

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—Con.		
3176	Horse Shoe Quick Acting Phosphate	Ubly	Claimed Found
3061	Horse Shoe Special Onion and Vegetable Manure	Mason	Claimed Found
3062	Horse Shoe Square Deal Phosphate	Ida	Claimed Found
3063	Horse Shoe Sugar Beet Fertilizer	Mason	Claimed Found
3205	Horse Shoe 3-8-6 Fertilizer	Brown City	Claimed Found
3064	Horse Shoe 10-5 Potash Manure	Wayne	Claimed Found
3065	Boar's Head Corn and Wheat Grower	Wyandotte	Claimed Found
3177	Boar's Head Dissolved Phosphate and Potash	Ruth	Claimed Found
3066	Boar's Head Faultless Grain Grower	Wyandotte	Claimed Found
3313	Boar's Head Faultless Grain Grower	Ruth	Claimed Found
3276	Boar's Head Gilt Edge Phosphate	Kingsland	Claimed Found
3067	Boar's Head High Grade Vegetable Fertilizer	Wyandotte	Claimed Found
3206	Boar's Head Potash Phosphate Fertilizer	Applegate	Claimed Found
3314	Boar's Head Potash Phosphate Fertilizer	Alma	Claimed Found
3207	Boar's Head Soluble Phosphate	Applegate	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	12 13.45	.... 2.32	10 11.13	....	$10 00 11 13
0.82 1.05	7 7.75	.... 1.70	5 6.05	10 10.82	17 72 20 21
....	16 18.20	.... 3.52	14 14.68	....	14 00 14 68
1.23 1.54	11 13.00	.... 2.80	9 10.20	2.00 2.05	15.98 18 65
2.47 2.49	10 10.90	.... 1.00	8 9.90	6 6.17	23 00 24 71
....	12 12.85	.... 2.15	10 10.70	5 5.57	14 50 15 71
1.65 1.77	10 11.70	.... 1.75	8 9.95	2 2.36	16 47 19 07
....	12 13.50	.... 2.47	10 11.03	2 2.41	11 80 13 20
0.82 1.04	9 10.50	.... 1.87	7 8.63	1 1.40	11 62 14 34
0.82 1.23	9 10.55	.... 1.80	7 8.75	1 1.54	11 62 15 24
....	16 18.55	.... 1.30	14 17.25	....	14 00 17 25
1.65 1.94	10 11.50	.... 2.15	8 9.35	5 5.40	19 17 21 97
....	12 12.80	.... 2.37	10 10.43	5 5.34	14 50 15 24
....	12 13.30	.... 2.36	10 10.94	5 5.73	14 50 16 10
....	12 13.95	.... 2.25	10 11.70	....	10 00 11 70

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Agricultural Chemical Co.—Con.		
3231	Boar's Head Sugar Beet Grower	Davison	Claimed.... Found.....
3232	Boar's Head Sure Growth Potash Manure	Alma	Claimed.... Found.....
3233	Boar's Head 10 per cent Potash Composition	Davison	Claimed.... Found.....
3279	Boar's Head World of Good Superphosphate	Portland	Claimed.... Found.....
	American Fertilizer Company, Chicago, Ill.		
3068	Union Brand Complete Crop Grower	Ypsilanti	Claimed.... Found.....
3315	Union Brand Complete Crop Grower	Pontiac	Claimed.... Found......
3069	Union Brand Corn and General Crop Grower	Saginaw	Claimed.... Found.....
3316	Union Brand Corn and General Crop Grower	Pontiac	Claimed.... Found.....
3070	Union Brand Dissolved Bone and Potash	Hudson	Claimed.... Found.....
3178	Union Brand General Cropper	Bad Axe	Claimed.... Found.....
3234	Union Brand High-Grade Acid Phosphate	Bay Port	Claimed.... Found.....
3071	Union Brand Gardeners Favorite	Bay City	Claimed.... Found.....
3179	Union Brand High Grade Celery and General Trucker	Deckerville	Claimed.... Found.....
3072	Union Brand High Grade Phosphate and Potash	Tecumseh	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.23 1.36	11 12.65	.... 2.15	9 10.50	2 2.28	$15 98 18 27
0.82 1.02	10 10.60	.... 1.42	8 9.18	3 3.22	14 42 16 28
0.82 0.94	7 7.80	.... 1.30	5 6.50	10 10.70	17 72 20 00
2.06 2.27	10 10.75	.... 0.17	8 10.58	1.50 1.71	17 48 20 27
1.65 2.26	.... 11.45	1.50 3.40	8 8.05	2 3.15	16 27 20 30
1.65 1.63	.... 11.00	1.50 2.74	8 8.26	2 2.38	16 27 17 30
0.82 0.97	.... 10.60	1 0.75	8 9.85	4 4.05	14 92 17 25
0.82 1.16	.... 10.50	1 0.90	8 9.60	4 3.78	14 92 17 46
0.40 0.84	.... 14.65	1 1.70	10 12.95	5 5.63	16 32 21 69
0.82 0.94	.... 10.55	1 2.20	8 8.35	1 1.25	12 22 13.70
....	.... 17.75	1 1.85	14 15.90	....	14 00 15 90
3.20 3.54	.... 12.30	2 4.15	9 8.15	10 10.98	30 19 32 29
0.82 0.86	.... 7.85	1 1.32	6 6.53	10 11.34	18 32 20 33
....	.... 13.20	1 1.55	10 11.65	2 3.32	11 80 14.64

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	American Fertilizer Co., Chicago, Ill.—Con.		
3317	Union Brand High Grade Phosphate and Potash....	Bad Axe.............	Claimed.... Found.....
3073	Union Brand High Grade Sugar Beet Grower.......	Bay City.............	Claimed.... Found.....
3074	Union Brand King's Favorite.....................	Ypsilanti.............	Claimed.... Found.....
3337	Union Brand King's Favorite.....................	Capac................	Claimed.... Found.....
3077	Union Brand Pure Bone Meal.....................	Hudson..............	Claimed.... Found.....
3078	Union Brand Pure Bone Meal and Potash..........	Tecumseh............	Claimed.... Found.....
3075	Union Brand Onion, Potato and Tobacco Grower....	Saginaw..............	Claimed.... Found.....
3076	Union Brand Onion, Potato and Tobacco Grower....	Tecumseh............	Claimed.... Found.....
3318	Union Brand Onion, Potato and Tobacco Grower....	Pontiac..............	Claimed.... Found.....
3079	Union Brand Steamed Bone Meal..................	Bay City.............	Claimed.... Found.....
	Armour Fertilizer Works, Chicago, Ill.		
3319	All Soluble..	Coloma..............	Claimed.... Found.....
3080	All Soluble..	Bay City.............	Claimed.... Found.....
3245	Ammoniated Bone with Potash..................	Camden..............	Claimed.... Found.....
3081	Armour's Bone Meal............................	Lansing..............	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 12.10	1 2.08	10 10.02	2 2.47	$11 80 12 24
1.65 1.64	.... 11.60	1.50 3.20	8 8.40	5 5.05	18 97 20 07
0.82 1.08	.... 10.50	1 1.55	8 8.95	3 3.70	14 02 16 75
0.82 1.01	.... 10.30	1 2.28	8 8.02	3 3.32	14 02 15 51
2.50 2.60	25 25.65	....	....	....	28 91 29 78
0.82 [illegible]	20 20.50	....	....	3 3.86	21 62 22 22
1.65 1.78	.... 10.65	1.50 2.37	8 8.28	7 7.59	20 77 22 40
1.65 1.71	.... 12.05	1.50 2.15	8 9.90	7 8.49	20 77 24 49
1.65 1.67	.... 11.10	1.50 1.04	8 10.06	7 7.72	20 77 23 38
0.82 1.43	30 30.10	....	....	....	26 92 29 17
2.88 2.89	.... 10.45	0.50 1.46	8 8.99	4 4.18	22 05 23 61
2.88 3.16	.... 10.40	0.50 1.97	8 8.43	4 4.13	22 05 24 19
2.47 2.51	.... 8.30	0.50 2.22	6 6.08	2 2.52	16 80 18 18
1.65 2.47	27 28.10	....	....	....	27 47 31 28

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Armour Fertilizer Works, Chicago, Ill.—Con.		
3082	Armour's Standard	Lake Odessa	Claimed Found
3083	Banner Brand	Lake Odessa	Claimed Found
3084	Bone, Blood and Potash	Saginaw	Claimed Found
3085	Crop Grower	Lansing	Claimed Found
3320	Crop Grower	St. Louis	Claimed Found
3086	Fruit and Root Crop Special	Quincy	Claimed Found
3087	Grain Grower	Lansing	Claimed Found
3088	High Grade Potato	Quincy	Claimed Found
3339	High Grade Potato	Pigeon	Claimed Found
3280	Mixed Bone and Potash	Manufacturer's sample	Claimed Found
3208	Muriate of Potash	Nunica	Claimed Found
3180	Phosphate and Potash	Coopersville	Claimed Found
3283	Potash Trucker	Manufacturer's Sample	Claimed Found
3090	Soluble Phosphate and Potash	Saginaw	Claimed Found
3246	Star Phosphate	Camden	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
0.82 1.01	.... 9.90	0.50 1.65	8 8.25	3 3.20	$13 82 15 38
....	.... 13.05	0.50 1.62	10 11.43	8 8.25	17 20 18 86
4.11 4.04	.... 10.80	0.50 1.37	8 9.43	7 7.95	29 13 31 53
1.21 1.26	.... 9.95	0.50 1.54	8 8.41	2 2.01	14 31 15 32
1.21 1.28	.... 9.75	0.50 1.44	8 8.31	2 2.11	14 31 15 35
1.65 1.81	.... 10.45	0.50 1.70	8 8.75	5 5.68	18 57 20.98
1.65 1.77	.... 10.50	0.50 1.57	8 8.93	2 2.52	15 87 18 13
1.65 1.73	.... 9.80	0.50 1.16	8 8.64	10 10.79	23.07 24 97
1.65 1.74	.... 9.65	0.50 0.82	8 8.83	10 11.98	23 07 26 13
0.82 1.59	18 19.60	....	....	4 4.11	20 92 25 04
....	....	....	....	50 50.60	45 00 45 54
....	.... 12.40	0.50 0.80	10 11.60	2 2.35	11 80 13 72
0.82 0.90	.... 9.50	0.50 1.18	8 8.32	8 9.14	18 32 20 22
....	.... 12.30	0.50 1.22	10 11.08	4 4.14	13 60 14 81
....	.... 17.20	0.50 1.57	14 15.63	....	14 00 15 63

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Armour Fertilizer Works, Chicago, Ill.—Con.		
3089	Sugar Beet Special	Quincy	Claimed Found
3091	Sugar Beet Special	Saginaw	Claimed Found
3092	1-5-10 Fertilizer	Bay City	Claimed Found
3093	10-5 Fertilizer	Ida	Claimed Found
3094	Wheat, Corn and Oats Special	Lansing	Claimed Found
	Bash Fertilizer & Chemical Co., Ft. Wayne, Ind.		
3095	Bashumus Corn Special	Lansing	Claimed Found
3096	Bashumus Garden Special	Lansing	Claimed Found
3097	Bashumus Grain Grower	Lansing	Claimed Found
	Robert Binder Estate, Battle Creek, Mich.		
3247	Blood and Bone	Battle Creek	Claimed Found
	James Boland Rendering and Fertilizer Co., Jackson, Mich.		
3098	General Crop	Jackson	Claimed Found
3099	Sugar Beet	Jackson	Claimed Found
	International Agricultural Corporation. Buffalo Fertilizer Works, Buffalo, N. Y.		
3248	Bone Meal	Plymouth	Claimed Found
3209	Celery and Potato Special	Hudsonville	Claimed Found

1910, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
0.82 0.94	.... 10.40	0.50 2.17	8 8.23	4 4.65	$14 72 16 64
0.82 1.11	.... 10.90	0.50 1.72	8 9.18	4 4.41	14 72 17 79
0.82 0.90	.... 6.65	0.50 1.37	5 5.28	10 10.65	17 12 18 63
....	.... 11.50	0.50 0.95	10 10.55	5 5.11	14 50 15 15
0.82 1.02	.... 8.00	0.50 1.00	7 7.00	1 1.20	11 02 12 17
1.00 1.11	.... 9.95	1.00 0.30	8 9.65	4 4.65	15 56 17 91
1.00 0.82	.... 9.95	1 0.42	8 9.53	10 9.26	20 96 20 95
1.20 1.45	.... 9.40	1 1.44	8 7.96	2 2.06	14 48 15 55
5.25 6.22	13.17 15.85	....	....	....	29 24 34 83
1.25 3.40	.... 14.70	.... 8.15	7 6.55	1.25 1.25	12 58 23 04
2.50 3.10	.... 13.92	.... 3.10	10 10.82	3 2.74	21 60 25 57
2.90 3.58	22 22.20	....	....	....	27 92 30 51
1.60 1.63	.... 10.65	1 2.65	8 8.00	10 11.80	23 10 25 48

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	International Agricultural Corporation, Buffalo Fertilizer Works, Buffalo, N. Y.—*Con.*		
3100	Dissolved Potash.	Belleville	Claimed.... Found.....
3101	Extra Phosphate and Potash	Blissfield	Claimed.... Found.....
3102	Farmers Choice	Coldwater	Claimed.... Found.....
3321	Farmers Choice	Coopersville	Claimed.... Found.....
3103	General Crop	Coldwater	Claimed.... Found.....
3104	General Favorite	Blissfield	Claimed.... Found.....
3338	General Favorite	Coopersville	Claimed.... Found.....
3105	Lillie's Special, No. 1	Blissfield	Claimed.... Found.....
3106	Lillie's Special, No. 2	Coldwater	Claimed.... Found.....
3210	Ohio and Michigan Special	Hartford	Claimed.... Found.....
3107	York State Special	Coldwater	Claimed.... Found.....
	E. Burton, St. Joseph, Mich.		
3211	Meat and Bone Phosphate	St. Joseph	Claimed.... Found.....
	Chicago Fertilizer & Chemical Works, Chicago, Ill.		
3305	Animal Bone and Potash	Manufacturer's sample.	Claimed.... Found.....
3306	Universal Wheat, Corn and Oats	Manufacturer's sample.	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 15.45	1 1.12	14 14.33	....	$14 00 14 33
....	.... 12.07	1 1.90	10 10.17	8 8.03	17 20 17 40
0.80 1.36	.... 11.00	1 2.06	8 8.94	5 5.07	15 75 19 16
0.80 1.07	.... 11.20	1 1.78	8 9.42	5 5.20	15 75 18 62
....	.... 13 55	1 2.52	9 11.03	3 3.17	11 70 13 88
1.20 1.49	.... 10.53	1 2.25	8 8.28	2.50 3.24	14 92 17 41
1.20 1.47	.... 11.40	1 2.10	8 9.20	2.50 3.13	14 92 18 10
0.80 0.98	.... 12.50	1 2.82	9 9.68	2 2.14	14 05 16 23
1.60 1.78	.... 10.95	1 2.87	8 8.08	4 4.40	17 70 19 53
0.80 1.02	.... 14.10	1 2.00	10 12.10	1 2.28	14 15 18 58
1.60 1.52	.... 11.45	1 1.52	9 9.93	5 4.11	19 60 19 66
3 3.50	15 16.95	.... 4.52	.... 12.43	0.36 0.21	26 00 26 90
1.64 1.85	.... 11.10	2 1.60	8 9.50	2 2.42	16 44 18 90
0.82 1.14	.... 9.45	1 1.00	8 8.45	2 3.02	13 12 15 63

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Chicago Raw Products Co., Chicago, Ill.		
3265	Consumers Special Corn and Oats Fertilizer	Capac	Claimed Found
3212	Consumers Special Corn and Wheat Grower	Mayville	Claimed Found
3286	Consumers Special Farmers Favorite	Manufacturer's sample	Claimed Found
3264	Consumers Special High Grade Wheat Grower	Capac	Claimed Found
3213	Consumers Special Onion and Vegetable Grower	Mayville	Claimed Found
3214	Consumers Special Vine and Tree Grower	Mayville	Claimed Found
3322	Consumers Special Vine and Tree Grower	Capac	Claimed Found
	The Cincinnati Phosphate Co., Cincinnati, Ohio.		
3181	Black Soil Fertilizer	Grand Rapids	Claimed Found
3250	Bone and Phosphate Mixture Wheat Special	Lakeview	Claimed Found
3182	Dissolved Phosphate and Potash	Grand Rapids	Claimed Found
3323	Dissolved Phosphate and Potash	E. Saugatuck	Claimed Found
3111	Grain and Grass Grower	Hand Station	Claimed Found
3112	Tobacco, Potato and Beet Grower	Hand Station	Claimed Found
3324	Tobacco, Potato and Beet Grower	E. Saugatuck	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 11.80	1 0.97	10 10.83	2 2.32	$11 80 12 92
0.80 0.82	.... 10.25	1 0.66	8 9.59	4 4.47	14 85 16 79
0.80 0.87	.... 10.10	1 1.25	8 8.85	3 3.46	13 95 15 55
....	.... 11.40	1 0.87	10 10.53	5 5.07	14 50 15.09
....	.... 12.10	1 1.00	10 11.10	10 10.53	19 00 20 58
0.80 1.51	20 27.80	....	....	8 7.36	26 05 34 34
0.80 1.43	20 21.00	....	....	8 9.29	26 05 30 25
....	.... 11.00	1 0.80	8 10.20	8 8.07	15 20 17 46
1.60 1.67	.... 18.25	6 6.65	10 11.60	1 0.97	19 00 21 08
....	.... 12.75	1 0.97	10 11.78	4 4.21	13 60 15 57
....	.... 11.10	1 0.90	10 10.20	4 4.41	13 60 14 17
0.80 0.86	.... 10.35	1 1.20	8 9.15	2 2.19	13 05 14 66
0.80 0.84	.... 10.30	1 0.67	8 9.63	4 3.94	14 85 16 44
0.80 0.95	.... 10.60	1 0.52	8 10.08	4 3.85	14 85 17 14

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	The Cincinnati Phosphate Co., Cincinnati, Ohio.—*Con.*		
3113	Truck and Tobacco Fertilizer	Vermontville	Claimed Found
3215	Wheat Grower	Holland	Claimed Found
	Darling & Co., Chicago, Ill.		
3114	Big Potash Brand	Lansing	Claimed Found
3115	Chicago Brand	Birmingham	Claimed Found
3325	Chicago Brand	Dowagiac	Claimed Found
3287	Eight per cent Phosphate	Manufacturer's sample	Claimed Found
3116	Farmers Favorite Brand	Lansing	Claimed Found
3117	General Crop Brand	Bay City	Claimed Found
3340	General Crop Brand	Clinton	Claimed Found
3332	High Grade Acid Phosphate	Manufacturer's sample	Claimed Found
3183	Phosphate and Potash Brand	Sebewaing	Claimed Found
3216	Pure Bone and Potash	Mayville	Claimed Found
3252	Pure Bone and Potash	Charlotte	Claimed Found
3333	Pure Ground Bone	Manufacturer's sample	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.60 1.55	.... 7.65	1 1.00	6 6.65	6 6.08	$17 50 18 14
....	.... 17.00	1 1.62	14 15.38	....	14 00 15 38
1.24 1.21	.... 11.25	2 1.52	8 9.73	10 10.73	22 22 24 31
1.65 1.76	.... 11.10	2 1.67	8 9.43	2 2.16	16 47 18 31
1.65 1.88	.... 10.95	2 1.84	8 9.11	2 2.33	16 47 18 64
....	.... 9.20	.... 0.87	8 8.33	....	8 00 8 33
2.47 2.05	.... 11.05	2 1.76	8 9.29	4 5.14	21 20 21 92
0.82 0.93	.... 9.78	2 1.67	8 8.11	6 6.40	17 12 17 85
0.82 1.00	.... 10.80	2 1.24	8 9.56	6 6.32	17 12 19 31
....	.... 15.80	.... 1.10	14 14.70	....	14 00 14 70
....	.... 11.45	.... 0.60	10 10.85	2 2.68	11 80 13 26
1.65 1.52	24.25 26.15	....	....	6 6.18	30 67 31 89
1.65 1.63	24.25 26.40	....	....	6 6.71	30 67 32 96
1.85 2.19	28 30.00	....	....	....	28 98 31 80

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Darling & Co., Chicago, Ill.—*Con.*		
3118	Sugar Beet and Root Grower	Clinton	Claimed.... Found.....
3119	Sure Winner Brand	Clinton	Claimed.... Found.....
3266	Ten Five Brand	Lambs	Claimed.... Found.....
3120	Vegetable and Lawn Fertilizer	Coldwater	Claimed.... Found.....
3288	Kainit	Manufacturer's sample	Claimed.... Found.....
3289	Muriate of Potash	Manufacturer's sample	Claimed.... Found.....
3251	Nitrate of Soda	White Pigeon	Claimed.... Found.....
	German Kali Works, Baltimore, Md.		
3121	Kainit	Adrian	Claimed.... Found.....
3290	Muriate of Potash	Manufacturer's sample	Claimed.... Found.....
3291	Sulfate of Potash	Manufacturer's sample	Claimed.... Found.....
	Gleaners Clearing House Association, Detroit, Mich.		
3283	Gleaner Acid Phosphate	Manufacturer's sample	Claimed.... Found.....
3108	Gleaner Michigan Favorite	Mason	Claimed.... Found.....
3284	Gleaner Michigan General Grower	Manufacturer's sample	Claimed.... Found.....
3109	Gleaner Michigan Producer	Mason	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
1.65 1.91	.... 10.80	2 2.10	8 8.70	5 5.57	$19 17 21 35
0.82 0.77	.... 9.10	2 1.06	8 8.04	3 3.12	14 42 14 02
....	.... 11.20	.... 0.65	10 10.55	5 4.92	14 50 14 98
3.30 3.52	.... 10.85	2 2.07	8 8.78	7 7.05	26 86 28 50
....	....	....	....	12.40 15.72	11 16 14 15
....	....	....	....	50 51.98	45 00 46 78
14.75 14.88	....	....	....	....	52 51 52 97
....	....	....	....	12 13.32	10 80 11 99
....	....	....	....	50 50.66	45 00 45 59
....	....	....	....	48 48.54	43 20 43 69
....	.... 16.30	0.50 0.22	14 16.08	....	14 00 16 08
1.65 1.92	.... 10.90	0.50 2.25	8 8.65	4 4.55	17 67 20 49
0.82 0.83	.... 12.10	0.50 1.86	10 10.24	1 1.09	14 02 14 91
....	.... 12.50	0.50 1.00	10 11.50	8 8.65	17 20 19.29

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Gleaners Clearing House Association, Detroit, Mich.—*Con.*		
3110	Gleaner Michigan Special	Petersburg	Claimed
			Found
3285	Gleaner Phosphate and Potash	Manufacturer's sample	Claimed
			Found
	Grand Rapids Glue Co., Grand Rapids, Mich.		
3184	"Grand Rapids"	Grand Rapids	Claimed
			Found
	Grange Fertilizer Co., Detroit, Mich.		
3292	All Crops Special Fertilizer	Manufacturer's sample	Claimed
			Found
3293	Complete Manure	Manufacturer's sample	Claimed
			Found
3253	Corn, Oats and Grass Fertilizer	Plymouth	Claimed
			Found
3294	High Grade Concentrated Wheat Manure	Manufacturer's sample	Claimed
			Found
3122	Potato and Vegetable Fertilizer	Romulus	Claimed
			Found
3295	Wheat Fertilizer, No. 1	Manufacturer's sample	Claimed
			Found
3123	Wheat Fertilizer with Potash	Ypsilanti	Claimed
			Found
	Hirsh, Stein & Co., Chicago, Ill.		
3186	Calumet 14 per cent Acid Phosphate	Ubly	Claimed
			Found
3127	Calumet Bone Black Grain Grower	Reading	Claimed
			Found
3128	Calumet Bone Phosphate and Potash	Clayton	Claimed
			Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
0.82 0.80	.... 9.65	0.50 1.50	8 8.15	4 4.55	$14 72 15.70
....	.... 10.40	0.50 0.58	10 9.82	2 2.04	11 80 11.66
2.00 1.93	.... 20.50	5.00 5.87	10 14.63	1 0.70	20 02 24 48
1.03 1.02	10 10.95	.... 2.45	8 8.50	2 2.42	14 27 15 29
0.82 0.90	9 10.90	.... 1.30	7 9.60	1 1.21	11 62 14 40
1.65 1.66	10 11.40	.... 1.72	8 9.68	2 2.25	16 47 18 31
1.23 1.38	11 13.15	.... 2.07	9 11.08	2 2.30	15 98 18 89
0.82 1.02	10 11.50	.... 1.67	8 9.83	3 3.23	14 42 17 04
....	16 20.50	.... 3.10	14 17.40	....	14 00 17 40
....	12 13.85	.... 3.62	10 10.23	2 2.05	11 80 12.08
....	.... 17.50	1 1.02	14 16.48	....	14 00 16 48
2.05 2.08	.... 11.05	1 1.72	8 9.33	1.50 1.86	17 05 19 09
....	.... 11.85	1 0.82	10 11.03	2 2.55	11 80 13 33

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Hirsh, Stein & Co., Chicago, Ill.—*Con.*		
3129	Calumet Corn and Wheat Grower	Birmingham	Claimed Found
3185	Calumet Grain Grower	Washington	Claimed Found
3130	Calumet High Grade Bone Phosphate and Potash	Hudson	Claimed Found
3131	Calumet Potato, Tobacco and Onion Grower	Deerfield	Claimed Found
3187	Calumet Special Grape Fertilizer	Memphis	Claimed Found
3217	Calumet Special 10 per cent Potash Manure	Zeeland	Claimed Found
3334	Calumet Sugar Beet and General Crop Fertilizer	Manufacturer's sample	Claimed Found
3188	Calumet Sure Growth Fertilizer	Washington	Claimed Found
3189	Calumet 10–10 Hummer Potash Phosphate	Washington	Claimed Found
3132	Calumet Wheat, Corn and Oats Special	Hudson	Claimed Found
	The Independent Packers Fertilizing Co., Columbus, Ohio.		
3133	Number 3, Corn, Wheat, Oats and Clover	Addison	Claimed Found
3134	Number 4, Tobacco, Potato, Onion and Truck Special	Addison	Claimed Found
3135	Number 8, Phosphate and Potash	Addison	Claimed Found
3136	Number 11, Special Sugar Beet Fertilizer	Addison	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
0.82 0.77	.... 9.85	1 0.65	8 9.20	4 4.65	$14 92 16 39
1.60 1.56	.... 11.90	1 1.65	8 10.25	2 2.68	15 90 18 88
....	.... 11 95	1 1.02	10 10.93	5 5.00	14 50 15 43
1.60 1.64	.... 11.25	1 2.20	8 9.05	5 5.93	18 60 21 11
0.80 1.14	20 24.00	....	....	8 8.10	26 05 30 55
0.82 0.79	.... 6.60	0.50 1.02	5 5.58	10 9.72	17 12 17 56
1.24 1.80	.... 10.35	1 1.43	9 8.92	2 2.70	15 62 18 33
0.80 1.00	.... 11.10	1 1.00	8 10.10	2 2.26	13 05 16 09
....	.... 13.20	1 0.52	10 12.68	10 10.67	19 00 22 28
0.82 0.77	.... 10.95	1 1.35	8 9.60	3 3.29	14 02 15 84
0.82 1.01	.... 10.85	.... 1.05	8 9.80	4 4.66	14 52 18 00
0.82 0.94	.... 8.35	.... 1.00	6 7.35	8 8.76	16 12 18 98
....	.... 11.80	.... 0.35	10 11.45	2 3.91	11 80 14 97
0.82 0.97	.... 9.35	1 0.92	8 8.43	4 4.41	14 92 16.22

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	The Jarecki Chemical Co., Sandusky, Ohio.		
3137	Black Soil Special	Readimg	Claimed.... Found.....
3138	C. O. D. Phosphate	Mason	Claimed.... Found.....
3139	Fish, Phosphate and Potash Tobacco and Potato Food	Adrian	Claimed.... Found.....
3140	Lake Erie Guano with Phosphate and Potash	Reading	Claimed.... Found.....
3141	Number One Formula	Tecumseh	Claimed.... Found.....
3142	Special Sugar Beet Grower	Petersburg	Claimed.... Found.....
3143	Square Brand Phosphate and Potash	Tecumseh	Claimed.... Found.....
3254	Tobacco and Truck Grower	Zeeland	Claimed.... Found.....
	Kalamazoo Rendering and Fertilizer Co., Kalamazoo, Mich.		
3335	Kazoo	Manufacturer's sample.	Claimed.... Found.....
	Natural Guano Co., Aurora, Ill.		
3218	Sheep's Head Brand Pulverized Sheep Manure	Benton Harbor	Claimed.... Found.....
	Nitrate Agencies Co., Chicago, Ill.		
3296	Acid Phosphate	Manufacturer's sample.	Claimed.... Found.....
3297	Muriate of Potash	Manufacturer's sample.	Claimed.... Found.....
3298	Nitrate of Soda	Manufacturer's sample.	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 9.20	1 0.70	8 8.50	8 8.17	$15 20 15 85
....	.... 18.40	1 1.32	14 17.08	....	14 00 17 08
0.83 0.87	.... 9.75	1 1.20	8 8.55	4 4.36	14 95 16 04
1.25 1.35	.... 10.30	1 1.67	8 8.63	2.50 2.94	15 10 16 76
0.83 0.91	.... 11.50	1 0.92	8 10.58	2 2.01	13 16 16 00
0.83 0.86	.... 9.90	1 0.60	8 9.30	4 4.20	14 96 16 38
....	.... 11.75	1 1.40	10 10.35	2 2.07	11 80 12 21
1.66 1.76	.... 6.62	1 0.82	6 5.80	6 7.39	17 71 19 05
1.50 2.09	.... 8.35	2.50 5.30	6 3.05	3 5.48	15 04 17 54
2.25 2.65	.... 1.80	.... 0.17	1.50 1.63	1.50 2.17	10 85 13 08
....	.... 16.90	.... 2.02	14 14.88	....	14 00 14 88
....	....	....	....	50 50.56	45 00 45 50
15 15.09	....	....	....	....	53 40 53 72

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	The Packers Fertilizer Co., Cincinnati, Ohio.		
3336	Acidulated Phosphate and Potash	Manufacturer's sample.	Claimed....
			Found.....
3192	Animal Tankage Phosphate and Potash	Sebewaing	Claimed....
			Found.....
3193	High Potash Manure	Sebewaing	Claimed....
			Found.....
3307	Phosphate with Humus	Manufacturer's sample.	Claimed....
			Found.....
3194	Sweepstakes	Sebewaing	Claimed....
			Found.....
	Pioneer Fertilizer Co., Chicago, Ill.		
3146	Pioneer General Crop Grower	Ypsilanti	Claimed....
			Found.....
3341	Pioneer General Crop Grower	Kibbie	Claimed....
			Found.....
3147	Pioneer High Grade Acid Phosphate	Dundee	Claimed....
			Found.....
3148	Pioneer High Grade Phosphate and Potash	Dundee	Claimed....
			Found.....
3299	Pioneer 1-7-1 Fertilizer	Manufacturer's sample.	Claimed....
			Found.....
3219	Pioneer Potato and Vegetable Grower	Kibbie	Claimed....
			Found.....
3149	Pioneer Truck and Corn Grower	Dundee	Claimed....
			Found.....
	The Pulverized Manure Co., Chicago, Ill.		
3144	Wizard Brand Manure	Detroit	Claimed....
			Found.....
3145	Wizard Brand Pulverized Sheep Manure	Lansing	Claimed....
			Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
....	.... 13.40	1 1.54	10 11.96	2 2.55	$11 80 14 26
0.80 0.83	.... 10.15	1 0.37	8 9.78	4 4.56	14 85 16 98
0.80 0.81	.... 8.05	1 1.05	6 7.00	8 8.18	16 45 17 66
0.40 0.44	.... 15.90	1 1.14	12 14.76	....	13 82 16 79
1.20 1.56	.... 10.45	1 1.51	8 8.94	2.50 2.35	14 92 17 20
1.65 1.85	.... 12.35	1 4.70	8 7.65	2 2.21	16 07 18 11
1.65 1.56	.... 11.10	1 1.52	8 9.58	2 2.98	16 07 18 43
....	.... 17.10	1 1.07	14 16.03	....	14 00 16 03
....	.... 12.70	1 1.02	10 11.68	4 3.88	13 60 15 17
0.82 1.10	.... 9.85	1 2.20	7 7.65	1 1.96	11 22 14 22
1.65 1.44	.... 11.15	1 1.55	8 9.60	7 7.33	20 57 21 95
0.82 0.88	.... 10.75	1 1.35	8 9.40	4 4.25	14 92 16 90
1.80 2.01	.... 1.75	.... 0.17	1 1.58	1 2.09	8 31 10 68
1.80 2.64	.... 1.75	.... 0.10	1 1.65	1 1.96	8 31 12 85

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Elmer D. Smith & Co., Adrian, Mich.		
3303	Fertilene	Manufacturer's sample	Claimed.... Found.....
	The Smith Agricultural Chemical Co., Columbus, Ohio.		
3190	Black Soil Formula	Verona Mills	Claimed.... Found.....
3150	Special Potato Formula	Quincy	Claimed.... Found.....
3255	Chicago Fertilizer Co's. B. B. & P. Brand	Petersburg	Claimed.... Found.....
3151	Chicago Fertilizer Co's. Calumet Phosphate	Carlton	Claimed.... Found.....
3152	Chicago Fertilizer Co's. Diamond Phosphate and Potash.	Carlton	Claimed.... Found.....
3153	Chicago Fertilizer Co's. New Leader	Quincy	Claimed.... Found.....
3154	Chicago Fertilizer Co's. Potash Special	Petersburg	Claimed.... Found.....
3155	Chicago Fertilizer Co's. Western Phosphate and Potash.	Petersburg	Claimed.... Found.....
3156	Ohio Farmers' Ammoniated Phosphate and Potash	Adrian	Claimed.... Found.....
3256	Ohio Farmers' Climax Phosphate	Hillsdale	Claimed.... Found.....
3157	Ohio Farmers' Corn, Oats and Wheat Fertilizer	Adrian	Claimed.... Found.....
3257	Ohio Farmers' Excelsior Phosphate	Petersburg	Claimed.... Found.....
3258	Ohio Farmers' Soluble Phosphate and Potash	Hillsdale	Claimed.... Found.....
3158	Ohio Farmers' Wheat Maker and Seeding Down	Adrian	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
12 12.75	... 26.50	... ...	25 26.50	25 25.82	$90 22 95 13
... ...	... 11.65	... 0.87	10 10.78	10 10.93	19 00 20 52
0.80 0.95	... 8.85	... 1.12	6 7.73	10 11.33	17 85 21 76
1.60 1.62	... 10.70	... 2.67	8 8.03	2 2.31	15 50 16 95
... ...	... 11.85	... 1.10	10 10.75	2 2.31	11 80 12 83
... ...	... 12.05	... 0.90	10 11.15	5 6.41	14 50 16.92
0.80 0.93	... 9.95	... 1.15	8 8.80	7 7.46	17 15 19 28
0.80 0.90	... 10.55	... 1.45	8 9.10	4 4.68	14 45 17 09
0.80 0.94	... 10.00	... 1.55	8 8.45	2 2.38	12 65 14 56
0.80 0.87	... 10.20	... 1.32	8 8.88	4 4.32	14 45 16 40
... ...	... 10.80	... 0.90	10 9.90	5 5.40	14 50 14 76
1.60 1.76	... 10.45	... 1.32	8 9.13	2 2.50	15 50 18 17
0.80 0.97	... 9.65	... 1.05	8 8.60	7 7.46	17 15 19 18
... ...	... 11.75	... 1.20	10 10.55	2 2.30	11 80 12 62
0.80 0.94	... 10.20	... 1.50	8 8.70	2 2.13	12 65 14 56

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Speidel & Swartz, Grand Haven, Mich.		
3220	Celery Hustler	Grand Haven	Claimed.... Found.....
	Sullivan Packing Co., Detroit, Mich.		
3308	Crystal	Manufacturer's sample.	Claimed.... Found.....
	Swift & Co., Chicago, Ill.		
3159	Bean and Grain Grower	Petersburg	Claimed.... Found.....
3326	Bean and Grain Grower	Capac	Claimed.... Found.....
3160	Complete Fertilizer	New Boston	Claimed.... Found.....
3260	Early Potato and Vegetable Grower	Dearborn	Claimed.... Found.....
3342	Early Potato and Vegetable Grower	Jackson	Claimed.... Found.....
3261	Garden City Phosphate	Reading	Claimed.... Found.....
3161	Onion, Potato and Tobacco Fertilizer	Leslie	Claimed.... Found.....
3195	Park and Lawn Fertilizer	Grand Rapids	Claimed.... Found.....
3221	Potato, Celery and Onion Grower	Zeeland	Claimed.... Found.....
3163	Pure Dissolved Animal Bone and Potash	Dundee	Claimed.... Found.....
3162	Pure Bone Meal	Jackson	Claimed.... Fund......
3343	Pure Bone Meal	Grand Rapids	Claimed.... Found.....

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
6 6.01	.... 4.90	0.69 1.77	3.17 3.13	1.25 1.25	$25 94 26 37
6.50 7.58	.... 7.25	0.50 2.62	6 **4.63**	0.75 **0.36**	30 02 32 98
0.82 1.05	.... 10.45	1 1.45	8 9.00	3 2.92	14 02 15 95
0.82 0.95	.... 10.35	1 1.44	8 8.91	3 3.35	14 02 15 89
0.82 1.07	.... 10.55	1 1.57	8 8.98	1 2.01	12 22 15 23
3.29 **3.07**	.... 7.60	1 1.02	6 6.58	10 10.32	27 12 27 21
3.29 3.69	.... 9.00	1 1.40	6 7.60	10 11.56	27 12 31 70
....	.... 16.15	1 1.17	14 14.98	....	14 00 14 98
1.65 1.71	.... 11.45	1 0.90	8 10.55	7 7.42	20 57 23 68
6.58 6.54	8 9.00	....	....	....	29 85 30 50
0.82 0.79	.... 7.50	1 1.02	5 6.48	10 10.02	17 32 18 72
1.44 1.74	.... 20.80	2 5.32	16 **15.48**	4 4.16	25 53 27 54
2.47 2.49	24 25.60	....	....	....	28 00 29 35
2.47 3.25	24 25.30	....	....	....	28 00 31 82

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Swift & Co., Chicago, Ill.—*Con.*		
3235	Pure Raw Bone Meal	Grand Rapids	Claimed Found
3164	Special Phosphate and Potash	Petersburg	Claimed Found
3165	Sugar Beet Grower	Bay City	Claimed Found
3327	Sugar Beet Grower	Hudsonville	Claimed Found
3191	Sugar Beet Special	St. Clair	Claimed Found
3328	Superphosphate	New Boston	Claimed Found
3166	Superphosphate	Hudson	Claimed Found
3167	Truck Grower	Reading	Claimed Found
3262	Muriate of Potash	Reading	Claimed Found
	Tuscarora Fertilizer Co., Chicago, Ill.		
3300	Acid Phosphate	Manufacturer's sample.	Claimed Found
3222	Ammoniated Phosphate	New Buffalo	Claimed Found
3223	Bone and Potash	New Buffalo	Claimed Found
3267	Michigan Special	Port Huron	Claimed Found
3301	Tuscarora Bone Phosphate	Manufacturer's sample.	Claimed Found
3224	Tuscarora Fruit and Potato	New Buffalo	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
3.75 3.96	23 24.05	....	....	....	$31 75 33 33
....	.... 12.10	1 1.15	10 10.95	2 2.05	11 80 12 80
2.47 1.91	.... 10.90	1 2.49	8 8.41	5 4.88	21 70 20 60
2.47 2.31	.... 10.45	1 2.37	8 8.08	5 5.46	21 70 22 17
0.82 1.07	.... 10.65	1 1.27	8 9.38	3 3.02	14 02 16 42
1.65 1.70	.... 11.60	1 2.32	8 9.28	2 2.28	16 07 18 31
1.65 1.63	.... 11.10	1 2.72	8 8.38	2 2.18	16.07 17.23
0.82 0.95	.... 11.55	1 2.00	8 9.55	4 4.07	14 92 17 39
....	....	....	....	50 54.11	45 00 48 70
....	.... 15.30	0.50 0.25	14 15.05	....	14 00 15.05
0.82 1.04	.... 8.00	0.50 1.00	7 7.00	1 1.25	11 02 12 23
....	.... 12.20	0.50 2.10	10 10.10	2 2.12	11 80 12 01
1.65 1.74	.... 10.35	0.50 2.12	8 8.23	5 5.30	18 57 20 04
....	.... 11.10	0.50 0.85	10 10.25	....	10 00 10 25
1.65 1.59	.... 9.90	0.50 1.42	8 8.48	10 10.71	23 07 24 35

Results of analyses of commercial fertilizers for

Laboratory number.	Trade name.	Locality where sample was taken.	
	Tuscarora Fertilizer Co., Chicago, Ill.—*Con.*		
3268	Tuscarora Garden	Port Huron	Claimed Found
3225	Tuscarora Standard	New Buffalo	Claimed Found
3226	Wolverine Special	New Buffalo	Claimed Found
	The Wuichet Fertilizer Co., Dayton, Ohio.		
3302	Buckeye Phosphate	Manufacturer's sample	Claimed Found
3168	Gem	Saginaw	Claimed Found
3329	Gem	Pewamo	Claimed Found
3169	Miami	Mason	Claimed Found
3170	Onion and Truck	Saginaw	Claimed Found
3330	Onion and Truck	Pewamo	Claimed Found
3171	Potash Special	Mason	Claimed Found
3331	Potash Special	Mason	Claimed Found
3227	Ruby	Ashley	Claimed Found
3236	Spot Cash Fertilizer	Howell	Claimed Found
3172	Superior Pure Raw Bone	Mason	Claimed Found

1912, expressed in parts per one hundred.—Con.

Nitrogen.	Phosphoric Acid.			Potash.	Valuation.
	Total.	Insoluble.	Available.		
2.88 3.02	... 10.80	0.50 1.97	8 8.83	4 4.10	$22 05 24 06
1.65 1.71	... 11.35	0.50 2.60	8 8.75	2 2.50	15 87 18 13
0.82 1.02	... 12.10	0.50 2.02	8 10.08	4 4.69	14 72 18 74
... ...	... 21.40	1 0.52	16 20.88	... ...	16 00 20 88
0.80 0.97	... 12.80	1 2.05	8 10.75	5 3.84	15 75 18 48
0.80 0.87	... 11.45	1 2.00	8 9.45	5 5.07	15 75 17 91
0.80 0.83	... 13.65	1 3.75	9 9.90	3 3.15	14 95 17 19
1.60 1.92	... 12.90	1 1.95	8 10.95	8 7.28	21 30 25 11
1.60 1.44	... 13.20	1 3.30	8 9.90	8 7.24	21 30 22 87
0.80 0.70	... 9.25	1 1.37	5 7.88	11 9.33	18 15 19 32
0.80 0.78	... 7.40	1 1.14	5 6.26	11 12.45	18 15 20 71
0.80 1.05	... 11.90	1 2.40	9 9.50	1 1.45	13 15 15 51
1.60 1.40	... 14.75	1 4.80	9 9.95	2 2.36	16 90 18 98
3.20 3.48	20 22.10	... ...	... ...	... ...	27 39 30 08

BULLETIN 270 **DECEMBER, 1912**

MICHIGAN

AGRICULTURAL COLLEGE

EXPERIMENT STATION

BOTANICAL DEPARTMENT

SEED ANALYSES

FOR 1911-1912

BY

ERNST A. BESSEY

EAST LANSING, MICHIGAN

1912

The Bulletins of this Station are sent free to all newspapers in the State and to such individuals interested in farming as may request them. Address all applications to the Director, East Lansing, Michigan.

MICHIGAN AGRICULTURAL EXPERIMENT STATION

Postoffice and Telegraph address, - - - - - -	East Lansing, Mich.
Railroad and Express address, - - - - - - -	Lansing, Mich.

A DEPARTMENT OF THE STATE AGRICULTURAL COLLEGE, AND, WITH IT, CONTROLLED BY THE

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STATE BOARD OF AGRICULTURE

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SUB-STATIONS.

Chatham, Alger County, 760 acres deeded—R. G. Carr in charge.
Grayling, Crawford County, 80 acres deeded.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded—Frank A. Wilkin in charge.

SEED ANALYSES FOR 1911 AND 1912.

BY ERNST A. BESSEY, PROFESSOR OF BOTANY.

The act regulating the sale of agricultural seeds (No. 289 of the Public Acts of 1909) is out of print and cannot be obtained except in complete volumes of the Public Acts of 1909. It is accordingly given in full as follows[1]:

AN ACT TO REGULATE THE SALE OF AGRICULTURAL SEEDS AND FRUIT TREES.

The People of the State of Michigan enact:

SECTION 1. Every lot of seeds of agricultural plants whether in bulk or in package, containing one pound or more, except sweet corn, beans, peas, cucumbers, melons, pumpkins, squashes, but including all cereals, grains, clover, alfalfa and garden plants which are sold, offered or exposed for sale for seed by any person or persons in Michigan, shall conform to the standards of purity and freedom from foreign matter specified in sections six and seven of this act, and all fruit trees, including apple, pear, peach, cherry and plum, shall be true to name for which they are sold: *Provided*, That mixtures of seeds, grains and cereals may be sold as such when the percentage of the various constituents is stated in a written or printed guarantee, which must accompany each package or lot sold or offered for sale.

SEC. 2. Dealers may base their guarantee on tests conducted by themselves or their agents: *Provided,* That such tests comply with methods prescribed by the director of the experiment station.

SEC. 3. The said director may take in person or by deputy, a sample of the seeds, grains or cereals which are mentioned in section one of this act, not exceeding four ounces in weight, for said analysis, from any lot or package of agricultural seeds which may be in the possession of any grower, importer, agent or dealer in the State. Such samples shall be taken in the presence of the person who sold or offered or exposed or had them in his possession for sale, or they shall be taken in the presence of two impartial witnesses, and in accordance with the rules for the seed testing prescribed by the director of the experiment station, and shall be enclosed in a sealed package, together with a certified statement of the person taking the sample, which statement shall include the name and address of the person who sold or offered, exposed or had in his possession for sale, the seeds from which

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[1] The spelling and punctuation of the originai act are followed, although there were some errors in each.

The Experiment Station has issued several valuable publications on the growing of alfalfa but a need has been felt during the past few years of a more recent publication on this subject. In order to learn with what success alfalfa is being seeded and what methods are giving the best results and to secure other data for such a bulletin, report blanks as per copy below were sent to a large number of farmers, who in recent years have corresponded with the College in regard to the growing of alfalfa.

MICHIGAN AGRICULTURAL COLLEGE

DEPARTMENT OF FARM CROPS

ALFALFA REPORT

The farmer receiving this blank is requested to answer the following questions in regard to his experience in growing alfalfa and return the same to the above address. The information received will be of great value to the College in studying the conditions under which alfalfa is grown in Michigan and the results of the investigation will be published in bulletin form.

If exact data is not available please make as close approximation as possible.

Name of farmer making this report.................................Address................
County...............................Distance and direction from town....................
Is your alfalfa field clay, clay loam, sandy loam or sandy?...............................
What is the nature of the subsoil?...
Is the field level or rolling?...
Is the soil porous so that natural drainage through the soil is good?....................
At what depth do you find standing water?..
Is there any tile drainage in the field or is any needed?................................
What is the condition to the field as to fertility?......................................
What crops have been grown on the field for 2 or 3 years previous to seeding alfalfa?...............
....
Was alfalfa ever seeded on the field before?...
Has the field been very weedy during the past few years?.........................Did you plow in preparing to seed alfalfa, if so, when?......................Did you roll the field?............
How many times did you harrow or cultivate the field?....................................
Was the field quite solid and firm at the time of seeding or was it loose and soft like a cornfield usually is at time of planting?...
Was any manure applied? If so, state amount and kind and whether top dressed or plowed under....
....
Was any fertilizer used? If so, state kind and amount.....................................
....
Was any lime used? If so, state kind, amount and method of application...................
....
Did you inoculate the soil? If so, how?..
Is the wild sweet clover common about roads and waste places? If so, how close to field?............
How many acres were seeded in this field?..
What was the approximate date of seeding?.....................................19.......
How was the seed applied and covered?..
How many pounds were seeded per acre?..
Where did you purchase the seed and was it northern grown?................................
Did you inoculate the seed, if so, where did you get the nitro-culture and how many days after its receipt before it was applied to the seed?...
....
Did you sow any other crop with the alfalfa as a nurse crop, if so, what, and how much seed per acre?
....
When was the nurse crop cut?...
Was the alfalfa in good condition at this time and did it suffer from hot dry weather during the next few days?...
....
Did the alfalfa come up and make a thick even stand?......................................
Was the alfalfa of a healthy color and vigorous growth during the first season or was it yellowish with small spots of darker green and more vigorous growth?................................

Did you examine the roots for nodules, if so, did you find many?..............................
What treatment did you give the field the first season after seeding?..............................
Have there been many weeds in the field since seeding, if so, what kinds?..............................
....
Have you disced your alfalfa, if so, with what results?..............................
How many times do you cut your alfalfa in a season?..............................
What is your total yield of hay per acre?..............................
What is your estimated feeding value of the hay per ton?..............................
Have you pastured cattle or sheep on alfalfa, if so, with what results?..............................
Have you pastured hogs or other stock on alfalfa, if so, with what results?..............................
Have you ever attempted to grow a crop of alfalfa seed, if so, what crop did you save?..............................
What was the weather during bloom and after bloom?..............................
What was the total amount of seed produced and the yield of seed per acre?..............................
What is the total acreage of alfalfa on your farm at the present time?..............................
Do you require additional blanks to report other fields?..............................
What is your estimate of alfalfa as a farm crop in your section of the state?..............................
....
....
....
Discuss below any points not included in the above questions:..............................
....
....
....

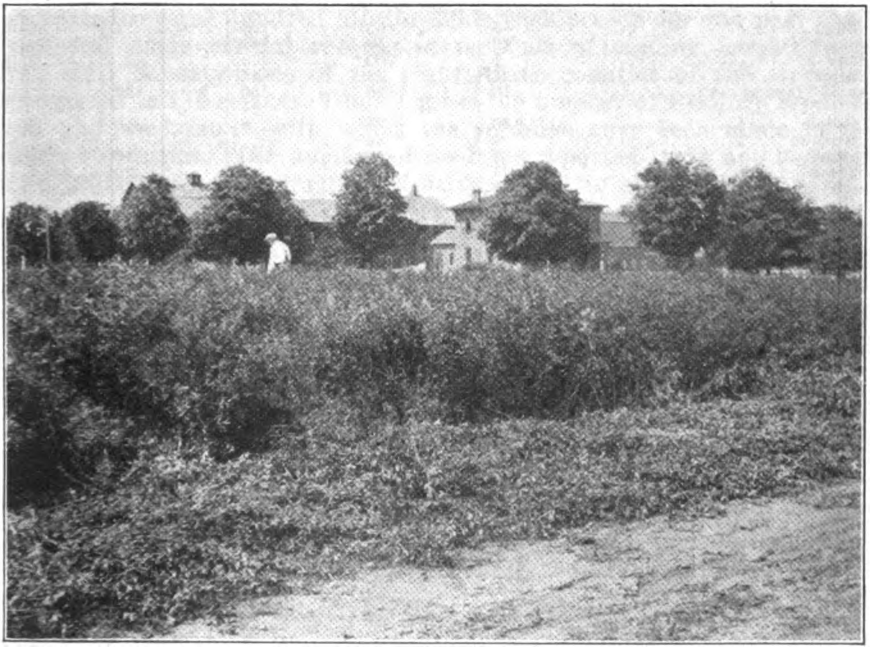

Fig. I. A plot of alfalfa on the college farm which has produced an average yield of 5.2 tons per acre during the past 4 years.

The first of these blanks were sent out in August, 1911. About seventy per cent of the seedings first reported upon were seeded previous to 1911. In August, 1912, a second blank was sent out to all who reported in 1911, so as to get additional data from the same fields. At the same time blanks were sent to a new list of alfalfa growers. The data for this

TABLE I.—RESULTS OF SEEDING ALFALFA BY COUNTIES.

Counties.	No. of seedings reported.	Percentage of reports graded as			
		Good.	Medium.	Poor.	Failure.
Alcona	1			100	
Allegan	38	53	23	13	11
Alpena	3	33		66	
Antrim	25	36	44	20	
Arenac	1		100		
Barry	20	47	38	9	6
Bay	20	50	50		
Benzie	8	50	25	25	
Berrien	22	55	18	13	14
Branch	27	52	30	7	11
Calhoun	43	56	16	19	9
Cass	19	47	16	37	
Charlevoix	5	20	40	40	
Cheboygan	9	44	33	22	
Chippewa	1	100			
Clare	3	67	33		
Clinton	11	45	35	20	
Crawford	1			100	
Dickinson	1	100			
Eaton	18	39	44	17	
Emmet	8	62	25		13
Genesee	12	58	42		
Gladwin	1	100			
Gratiot	4	75	25		
Grand Traverse	10	20	50	30	
Hillsdale	46	74	6	15	5
Houghton	2	50			50
Huron	6	50	33	16	
Ingham	11	57	13	29	
Iosco	8	62		38	
Ionia	9	77	22		
Iron	2	50		50	
Isabella	11	36	37	18	9
Jackson	33	64	23	9	3
Kalamazoo	18	55	24	11	10
Kalkaska	15	7	26	34	33
Kent	20	40	30	25	5
Lapeer	10	60	30	10	
Lake	2	50	50		
Leelanau	8		62	25	12
Lenawee	23	61	13	9	17
Livingston	10	50	50		
Luce	1	100			
Manistee	14	7	59	29	7
Mason	6	33	34	33	
Marquette	1				100
Macomb	7	57	28	14	
Mecosta	20	25	40	20	15
Menominee	10	30	30	40	
Midland	1		100		
Montcalm	25	36	24	28	11
Missaukee	4	25	25		50
Montmorency	1		100		
Monroe	11	54	27	9	9
Muskegon	18	39	17	22	22
Newaygo	14	28	43	21	7
Oakland	41	27	49	15	9
Oceana	11	35	28	19	18
Osceola	19	63	21	10	5
Otsego	7	57	28	14	

TABLE I.—Concluded.

Counties.	No. of seedings reported.	Percentage of reports graded as			
		Good.	Medium.	Poor.	Failure.
Ogemaw	4	50	25	25	...
Ottawa	20	45	20	30	5
Presque Isle	8	62	13	25	...
Saginaw	5	20	20	40	20
St. Clair	34	44	27	17	12
St. Joseph	10	60	20	20	...
Sanilac	16	75	13	12	...
Schoolcraft	1	...	...	100	...
Tuscola	7	57	43	...	...
Van Buren	24	46	25	25	4
Washtenaw	18	23	22	50	5
Wayne	20	35	35	25	5
Wexford	40	30	47	23	...

bulletin is based mainly upon these reports representing 701 different seedings and a total acreage of approximately 4065 acres. Much supplementary data has also been gathered by the College field agent, who has visited several hundred alfalfa fields each season for the past three years and made careful records of methods of seeding, condition of crop, etc. Seventy-three of the eighty-three counties of the state are represented in the reports. Table I gives the number of seedings reported upon and the results with which the seedings have been made in the different counties. The number of seedings reported must not be taken as an indication of the number of fields seeded to alfalfa in the several counties, as in most of the counties there are now a large number of seedings upon which reports have never been made to the College.

CAUSES OF FAILURE OR POOR RESULTS IN SEEDING ALFALFA.

The reports from farmers were first carefully graded as to whether the seedings produced good, medium or poor results or failure. Answers to several of the questions were studied in making these grades. In some cases it was difficult to determine the grade but it is thought that on the whole the grades represent fairly well the true conditions. So far as possible the grading of the reports of 1911 seedings (in regard to which there was most doubt) have been checked up by the 1912 reports. The reports that were graded poor or failure were then carefully studied as to the most conspicuous causes of these conditions, Table II giving the results of this study.

TABLE II.—PRINCIPAL CAUSES OF POOR RESULTS OR FAILURE IN SEEDING ALFALFA.

Poor preparation of seed bed	34.4%
Lack of inoculation	30.6%
Winter killing	12.4%
Weeds	9.7%
Light, infertile soil	5.9%
Seeding with nurse crop	4.3%
Insufficient drainage	2.7%

It will be noticed by the above table that the largest percentage of unsuccessful seedings resulted from insufficient preparation of the seed bed. To this number should be added the percentage of failures due to weeds as the weeds are the result of poor preparation of the seed bed. Failure to secure sufficient inoculation also accounts for a large percentage of the unsuccessful seedings. Twelve and four-tenths per cent of the failures were caused by winter killing. About 6.2 per cent of the total number of seedings were partially or wholly winter killed. The figures in the table indicate little as to whether the use of a nurse crop is advisable, but they show that in 4 3-10 per cent of the unsucessful seedings, the use of the nurse crop was the principal cause of failure. The Department's study of alfalfa fields over the state indicates that acid conditions of many Michigan soils account for many of the poor results in seeding alfalfa, but in most cases in the study of these reports it was either not the most conspicuous factor of failure or the lime was put on or left off the entire field so that the reports furnished little data on this point.

INFLUENCE OF TYPE OF SOIL AND CHOICE OF LOCATION FOR SEEDING ALFALFA.

In Table III the reports are classified according to the type of soil and subsoil and the groups are arranged in order of the percentages of successful seedings. In the first column of figures the number of seedings on the different types of soil are shown and in the last four columns are shown the results of seeding on the different types of soil.

TABLE III.—INFLUENCE OF SOIL IN SEEDING ALFALFA.

Soil.	Subsoil.	Number of seedings reported.	Percentage of seedings graded as			
			Good.	Medium.	Poor.	Failure.
Gravel	Clay	12	72.7	18.3	9.0	0
Gravel	Gravel	13	53.8	38.5	7.7	0
Clay loam	Gravel	14	50.0	42.9	7.1	0
Clay loam	Clay	172	52.7	29.0	16.5	1.8
Clay	Clay	28	51.8	29.7	14.8	3.7
Sandy loam	Clay	99	44.9	31.6	18.4	5.1
Sandy loam	Gravel	46	35.6	42.2	22.2	0
Sand	Clay	22	23.8	52.5	19.0	4.7
Sandy loam	Sand	54	28.3	34.0	26.4	11.3
Sand	Sand	69	14.7	33.8	39.8	11.7
Sand	Gravel	13	7.7	15.4	61.5	15.4
Total		542				

A classification of soils made by so many different parties must necessarily be somewhat inexact and doubtless some of these soils classified, for instance, as sand or sandy loam in one section of the state may be quite different from soils given the same classification in another section of the state. In one section the heavier soils and in another section the lighter soils may give best results.

Still some valuable information may be gained from these data. All the soils containing gravel either in the surface soil or subsoil, with the exception of the sand with a gravel, probably in most cases a sandy gravel subsoil, have given very good results. It is believed that these soils are well suited to the growing of alfalfa largely because of the good drainage to a sufficient depth to allow the deep root system of the alfalfa to develop. The sand soil with either a sand or gravel subsoil have given the poorest results, probably because of their relatively low state of fertility and their poor water holding capacity. It will be noticed that alfalfa is being grown successfully on all the types of soils and that on most of the types a fair percentage of the seedings have been successful.

In choosing a field of the farm for the growing of alfalfa, it is important to avoid poorly drained soil or that in which the water table lies within three or four feet of the surface. Likewise soils underlaid with rock or other impervious strata within a short distance of the surface should be avoided. However, most of the so-called hard pans of Michigan are not too hard for the alfalfa roots to penetrate when there is plenty of moisture in the soil. Muck soils and heavy inpervious clays are poorly suited to the growing of alfalfa.

Other things being equal the fertile soils are preferable to the infertile ones. In sections of the state where the lighter soil types prevail, the seeding of alfalfa is quite commonly a failure because of the unproductiveness of the soil. While the alfalfa after it is well established in the soil is a very hardy plant, it is very tender and very slow to develop in its early growth. Alfalfa is a very valuable crop on these lighter types of soil if a good stand can be secured and the alfalfa can be made to survive the first one or two seasons, but it is not advisable to sow alfalfa on many of these soils until some means are taken to improve them. Not only is the plant food lacking but there is very little organic matter and only a very limited water holding capacity. The best way to build up a soil of this type is to grow rye, vetch or other crops for plowing under.

In the better agricultural sections of the state it is frequently advisable to seed the alfalfa on the higher, lighter lands of the farm, because this land is well drained, because the alfalfa will do very well on land of this type and because this plan will leave the best land of the farm to be devoted to other crops.

So far as previous cropping is concerned, alfalfa may follow any crop of the farm providing a sufficient length of time is taken to prepare a suitable seed bed. It is not, however, advisable to break up sod, especially a June grass sod and seed alfalfa, since the sod is not apt to be sufficiently decomposed or the grass completely eradicated before seeding alfalfa. A cultivated crop, such as potatoes, corn, or beans in which thorough cultivation has been practiced is well suited to precede alfalfa. Alfalfa may also follow any of the small grain crops but it is not usually advisable to attempt to seed the alfalfa the same season, as the grain crop generally leaves the field in a rather dry condition so that it would be difficult to prepare a good seed bed sufficiently early.

PREPARATION OF THE SEED BED FOR ALFALFA.

In Table IV is given a summary of the reports based on the firmness of the seed bed, this condition being judged by the answers to this question and also those on the methods and length of time used in preparing the seed bed. In Table V is given another summary, based on the length of time in which the seed bed was in course of preparation. In these tables the importance of having a firm seed bed is clearly indicated and in the latter is shown the difficulty of securing this condition in the seed bed prepared in a short time. These data are borne out by observations of many alfalfa fields in which the stand has been better and the growth more satisfactory where the horses had turned or where the field for any reason had been more thoroughly firmed.

Another very important consideration in preparing to seed alfalfa is the eradication of the weeds. The alfalfa seed is rather slow to germinate and the young plants make a slow growth for sometime. As demonstrated by the Kansas Station about ½ of the plants in a normal stand of alfalfa die out in the first one or two years. Many of the weeds, especially such grasses as June Grass and quack grass are vigorous crowders and if they once get a foothold will, after a time, take possession of the field. Unlike the seeding of clover it is generally desirable to leave a good stand of alfalfa for several years. For these several reasons it is important to have the weeds more thoroughly eradicated than for other crops of the farm. It is not sufficient simply to have a seed bed free from weeds at the time of seeding but the soil should be cultivated long enough after plowing to germinate and destroy most of the weed seeds in the surface soil so that the alfalfa shall have but little competition from the weeds until it is sufficiently well established in the soil to make a rapid growth.

TABLE IV.—INFLUENCE OF SEED BED IN SEEDING ALFALFA.

Condition at time of seeding.	No. of seedings reported.	Percentage of reports graded as			
		Good.	Medium.	Poor.	Failure.
Firm	300	50.8	28.0	18.7	.2
Medium	120	44.0	35.0	16.0	.4
Loose	139	24.1	14.0	58.6	.3
Total	559				

TABLE V.—INFLUENCE OF SEED BED IN SEEDING ALFALFA.

Length of time in preparing seed bed.	No. of seedings reported.	Percentage of seedings graded as			
		Good.	Medium.	Poor.	Failure.
Eight weeks or longer	224	50.0	23.3	21.3	5.4
4 to 7 weeks	158	32.9	32.9	27.3	6.9
3 weeks or less	161	31.7	40.4	24.8	3.1
Total	543				

On the heavier types of soil, and in fields that are inclined to be foul, it is advised that the seed bed be prepared in the following manner: Plow late in the fall or as early as convenient in the spirng, roll and harrow, or harrow twice, immediately following the plow. Harrow once each week until late spring or early summer, when a good seed bed will have been prepared. The tramping of the horses and the rains falling during the spring months will have thoroughly firmed the soil underneath, the surface soil will be in a good tilth, the weeds in the surface soil will have been rather thoroughly eradicated and enough moisture will have been conserved to germinate the seed soon after sewing even though the seeding is done in a dry time.

In the earlier spring seedings the same method should be carried out so far as possible. In this case it is more important to plow in the fall but the soil should receive no other treatment until spring. A very good seed bed may be prepared without plowing, in fields which have received very thorough cultivation in a cultivated crop the preceeding season, or the alfalfa may follow to advantage a crop of early potatoes with little extra preparation of the seed bed. The condition especially to be avoided in seeding alfalfa is the loose, open seed bed, such as is prepared in plowing only a short time before seeding.

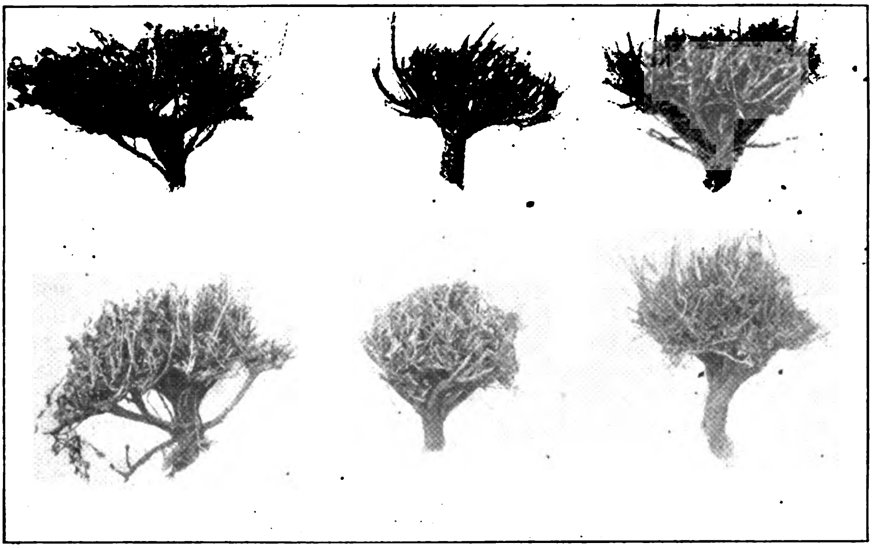

Fig. II. Alfalfa crowns. Notice the tap root, the large number of stalks and that some of the branches appear below the surface of the soil.

USE OF MANURE IN SEEDING ALFALFA.

On the seed bed which is in course of preparation for some time the use of manure is advisable. It may be applied before plowing and turned under or it may be applied soon after plowing and incorporated in the surface soil by harrowing. In either case the manure would add plant food to the soil, which is quite important under certain soil conditions and in the latter method would act also as a mulch and as a protection to the young alfalfa. On the seed bed which is prepared in a short time it is not advisable to use manure as a top dressing, because of its introduction of weed seeds and not, at least as a heavy coat, for turning under as it would tend to hold up the furrow slice and allow it to dry out. Another method of applying manure that is giving very satisfactory results is to spread with a manure spreader in the fall at the end of the season's growth. This is especially advisable in rather late seedings or when seeding on exposed fields which would be apt to winter kill badly.

USE OF FERTILIZERS IN SEEDING ALFALFA.

The large percentage of successful seedings reported and the small percentage of these in which commercial fertilizers have been used, indicate that its use is not as essential as the preparation of a suitable seed bed, inoculation with the alfalfa bacteria and several other factors. (Commercial fertilizers were used on 18.8 per cent of the total number of seedings reported upon.) There are doubtless conditions under which the judicious use of commercial fertilizers will enhance the chances of success in the seeding of alfalfa. Under other conditions fertilizers may be used with little if any apparant effect and certainly the use of fertilizers as a panacea for all the troubles of alfalfa growing is sure to result in a good many disappointments. This is a matter largely dependable upon local conditions. No attempt is here made to give any recommendations in regard to the use of fertilizers which will apply generally to farm conditions. It is suggested rather that simple experiments be conducted to learn what fertilizers, if any, may be used with profit under local conditions.

As a means of stimulating a more vigorous growth in new seedings of alfalfa, the use of 200 lbs. per acre of a complete fertilizer, such as a 2—8—6, for sandy or sandy loam soils, and a 2— 10— 4 for clay or clay loam soils is suggested. Other fertilizers of different analyses, both complete and incomplete, might also be included in the experiment.

Alfalfa has in numerous instances throughout the state produced satisfactory crops of three to five tons per acre on light loamy or gravelly soils of apparently low fertility and continued to do so for periods of five to fifteen years or more, so that there would seem to be little need of applying fertilizers after the alfalfa is well established in the soil. Since alfalfa is a leguminous crop, the supply of nitrogen would doubtless be maintained by the fixation of nitrogen from the atmosphere. Certainly it would not be a profitable investment to buy commercial nitrogen for applying to alfalfa fields after the first year. Some of the lighter Michigan soils, however, contain a rather low supply of phosphoric acid and this would tend to become exhausted by the continual removal of the crops. Our clay soils should contain a sufficient supply of potash for the production of satifactory crops for an indefinite period. The sandy soils which contain very little clay should, however, be benefitted by the application of potash. These requirements may be supplied in part at least by the application of a coat of well rotted manure annually. The application of 200 to 250 pounds of acid phosphate or 100 or 150 pounds of steam bone meal might be applied as an experiment on clay soils, as might also the same fertilizer with the addition of 75 to 100 pounds of muriate of potash on the sandy soils.

USE OF LIME IN SEEDING ALFALFA.

Only about twenty-five per cent of the farmers who filled out the report blanks used lime at all and over one-third of these applied it at less than 1000 pounds per acre. It is, therefore, evident, considering the large percentage of successful seedings, that the use of lime is not an essential factor in the seeding of alfalfa on many of the farms in Michigan. It is just as evident, however, as shown by many observations about the state and by numerous reports from farmers that, under certain soil conditions, the use of lime is quite essential to the growing of this crop.

Table VI shows the summarized results of the use of lime as compared with no lime.

TABLE VI.—INFLUENCE OF LIME IN GROWING ALFALFA.

Treatment.	No. of seedings reported.	Percentage of seedings graded as			
		Good.	Medium.	Poor.	Failure.
Limed	138	50.1	25.7	31.2	.1
Not limed	412	33.9	33.1	25.1	7.9

It is sometimes difficult to tell by preliminary study whether an application of lime is needed before seeding alfalfa. If the surface soil contains small shells or small pieces of limestone, it probably is not in an acid condition. Pebbles that are thought to be of limestone origin (and also the soil itself) may be tested by pouring on a small amount of hydrochloric or other acid. If an effervesence or bubbling takes place it indicates an alkaline condition, and an application of lime is not necessary. When much difficulty is experienced in producing satisfactory crops of red clover, it may be taken as an indication of some unfavorable condition, possibly an acid condition of the soil. The use of litmus paper is often of value in determining whether lime is necessary. In order to make this test, the blue litmus paper, should be purchased at a drug store, and the strips placed in the moist soil in various parts of the field and left there for five or ten minutes. If the paper turns to a reddish color it is said to indicate an acid condition of the soil. This, however, is rather a crude test and may be misleading either from the fact that the blue dye may be absorbed by the soil, leaving the paper red or because much of the litmus paper on the market is not sufficiently sensitive to determine slightly acid conditions of the soil. By far the most satisfactory method of determining this point is to apply lime on a portion of the field where alfalfa is being seeded. It is recommended that this be done in all cases of seeding alfalfa for the first time on the farm. The results of such a test will on the whole direct the farmer wisely in future seedings of alfalfa.

There are several forms of commercial lime which may be used to correct the acidity of the soil, the most important of these being as follows: ground limestone, or the finely pulverized raw rock; burned lime, or quick lime, which is produced from the raw rock by burning, the hyrdated lime which is the product of the application of water to the burned lime; and the air slacked lime, which is the burned lime which has been exposed to the atmosphere and has partially reverted to the hydrate and carbonate forms. The refuse lime from sugar factories is much the same as the air slacked lime but contains in addition a small percentage of nitrogen, phosphoric acid and potash. Marl is another available source in many sections of the state. The choice of the form of lime depends upon the relative price, the chemical composition, fineness of pulverization, cost of freight and hauling, etc. One hundred pounds of carbonate of lime, such as is found in the ground limestone and marl is equivalent to seventy-four pounds of hydrated lime and fifty-six pounds of burned lime. When marl or sugar factory lime may be applied without too great labor expense, these forms may be the cheapest that can be secured. In most sections of the state the ground limestone may be had at lower cost than other forms of commercial lime.

The amount of lime required depends upon the degree of the acidity of the soil, but as this is difficult to determine, it is recommended that the lime be applied at the rate of at least two tons per acre of the ground limestone or its equivalent in the other forms. There is no danger of applying too much of the carbonate forms up to several tons per acre and if a medium heavy application is made the value of the application is more certain to be determined and any soil acidity which may exist in the soil will remain corrected for a longer time than if a light application be made.

One of the most satisfactory methods of distributing the various pulverized forms of lime is to use one of the modern lime distributors, of which there are several on the market. Another satisfactory method is to use the manure spreader, filling the box about ½ full with manure and filling the remainder of the box with the lime. Fertilizer attachments to grain drills are sometimes used but this method is not so satisfactory when it is desired to apply a fairly large amount per acre. If the burned lime is the most convenient form to secure, this should be placed in small piles in the field until it absorbs enough moisture from the soil and air to become finely pulverized and then it may be spread with a shovel.

INOCULATION OF ALFALFA.

There is no question as to the importance of the bacteria which are associated with the various leguminous plants. In the absence of the bacteria the nodules do not develop on the roots and the plant is not able to take its nitrogen from the atmosphere. The legumionus crop thus becomes a soil robber the same as the non-leguminous crops and the growth is apt to be stunted and the crop unprofitable.

The red clover is so commonly grown in the Northern states that the bacteria which are associated with this species are thoroughly disseminated and artificial inoculation is generally of little if any value.

Alfalfa, however, is a new crop, with few exceptions never having been grown in the same field before, hence the need of introducing the bacteria artificially. The lack of inoculation has been found to be responsible for a very large percentage of the failures in the earlier seedings of alfalfa in Michigan. Even at the present time when alfalfa is being seeded so commonly and the chances are so much more favorable for inoculation by natural means, the artificial inoculation is practically essential to the securing of a successful seeding.

There are several ways in which the bacteria may be introduced into a new field e. g. by the application of soil from a field which has grown one or more tubercle bearing crops of alfalfa; by the use of pure cultures, which are generally applied to the seed; by the bacteria being carried by the seed from the old field to the new; by the growth of closely related species with which the same bacteria are associated; by the application of alfalfa manure; and by various natural means, such as moving water, wind, etc. The chief objections to the first method are the possible introduction of noxious weed seeds and in some cases the cost of transportation and application. This method has, however, given very satisfactory results, the farmers' reports as summarized in Table VII indicating that it is somewhat more reliable than to use the pure cultures. In using this method care should be exercised to get soil in which tubercle bearing plants are growing and to avoid exposing the soil to the sunlight. It is preferable to apply it on a cloudy day or at dusk and cover at once. The more of the inoculated soil that is applied the more certain of having sufficient bacteria so that every plant will develop the nodules in its early growth, but in case the soil is secured at considerable expense 400 or 500 lbs. per acre will answer very well. The use of pure culture is by far the most common method of inoculation now being used. It is inexpensive, easy of application and gives very satisfactory results.

TABLE VII.—INOCULATION FOR ALFALFA. SOIL VS. NITRO-CULTURE.

Method of inoculation.	No. of seedings reported.	Percentage of seedings reported as			
		Good.	Medium.	Poor.	Failure.
By soil from old alfalfa field or sweet clover patch	91	50.5	37.4	11.0	1.1
By nitro-culture	363	36.4	30.9	27.8	4.9

There are always some bacteria carried by the seed from the field where the seed was produced. This accounts for the small spots of alfalfa of rank, healthy growth frequently seen in the yellowish stunted growth of the uninoculated field. If the alfalfa survives for a year or two until the bacteria in these spots are disseminated by natural means a satisfactory stand may result, but this method should never be depended upon when alfalfa is being seeded on the field for the first time and it is desired to secure a full stand of alfalfa. A most excellent practice, however, is to seed a small amount of alfalfa with the regular seeding of clover each year, as the bacteria introduced in this way will spread naturally and produce a thorough inoculation by the time it is desired

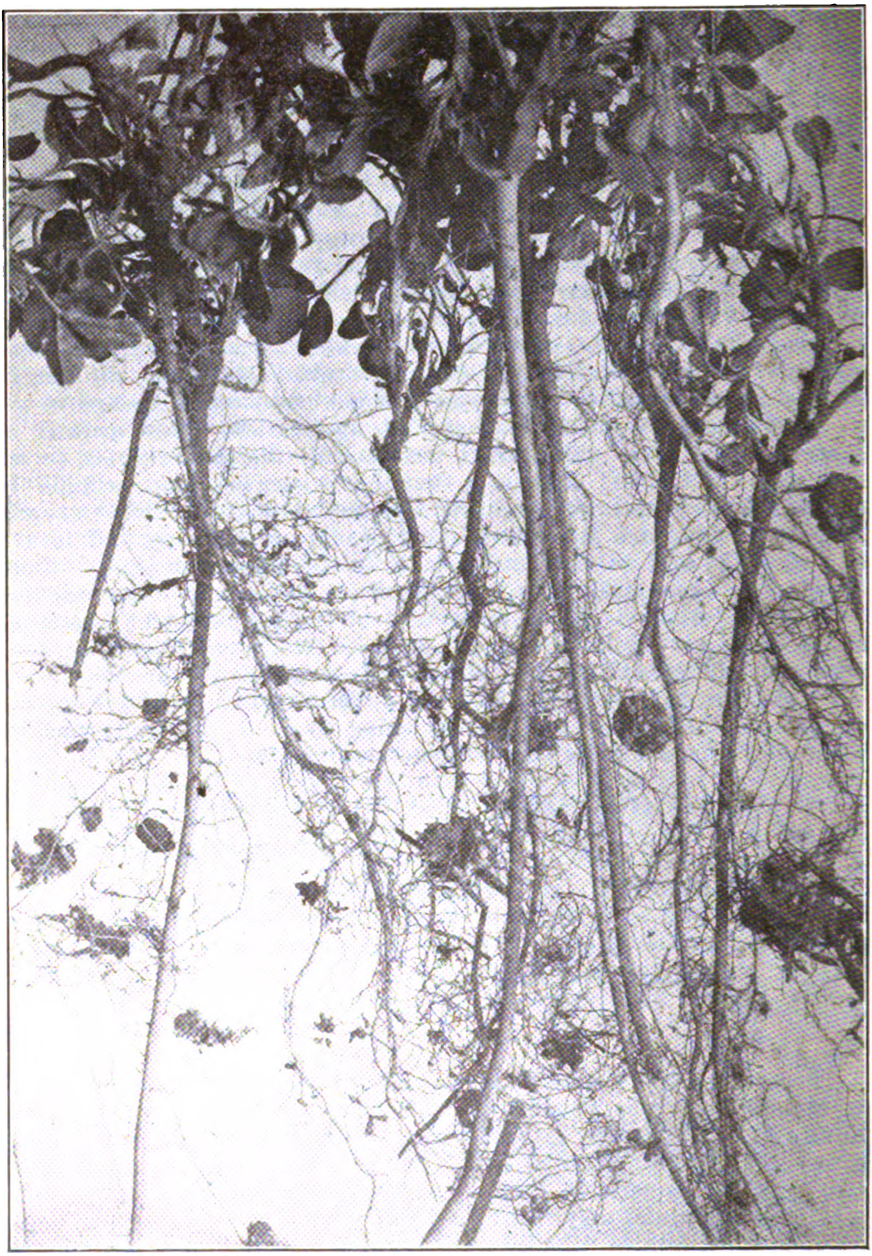

Fig. III. Showing the root and tubercle formation in young alfalfa plants. Notice that some of the tubercles are about the size of a pin head, while others are joined together in large clusters.

to seed alfalfa as a regular crop in the field a few years hence. In following this practice the seed should be treated with the nitroculture the same as though a full stand of alfalfa were desired.

The last three methods of inoculation are not frequently employed by the farmer but help to explain why some fields in which none of the common methods of inoculation have been used, produce an abundance of tubercles from the first. As the expense is so little and the risk of partial or complete loss of crop is so great in case the bacteria are not present, artificial inoculation should by all means be used whenever alfalfa is being seeded for the first time in the field. Soils that have grown satisfactory tubercle bearing crops of alfalfa harbor the bacteria for an indefinite time so that if alfalfa is seeded again in the field even after several years, the nodules will develop on the roots in abundance.

DATE OF SEEDING.

In studying the date of seeding alfalfa the reports were first classified according to the nature of the soil with the thought that different dates of seeding might be found to be best under the different soil conditions. The data from the seedings made on light infertile soils are included in Table VIII while those from the medium and heavy soils are included in Table IX.

TABLE VIII.—DATE OF SEEDING ALFALFA.—LIGHT SOIL.

Dates of seeding.	Number of seedings reported.	Percentage of seedings graded as			
		Good.	Medium.	Poor.	Failure.
April 15 or before	1	0	100.0	0	0
April 16 to 30	7	14.2	42.9	42.9	0
May 1 to 15	14	14.3	28.6	50.0	7.1
May 16 to 31	22	27.3	13.6	50.0	9.1
June 1 to 15	38	18.4	55.3	18.4	8.0
June 16 to 30	17	23.5	17.7	41.1	17.7
July 1 to 15	4	0	25.0	50.0	25.0
July 16 to 31	5	20.0	0	60.0	20.0
August 1 to 15	7	28.6	14.2	42.9	14.2
August 16 to 31	6	17.0	17.0	50.0	17.0
September 1 or later	6	17.0	33.0	17.0	33.0
Total	127				

TABLE IX.—DATE OF SEEDING ALFALFA.—MEDIUM AND HEAVY SOIL.

Dates of seeding.	Number of seedings reported.	Percentage of seedings graded as			
		Good.	Medium.	Poor.	Failure.
April 15 or before	24	41.6	29.1	29.1	0
April 16 to 30	34	35.3	47.1	14.6	2.9
May 1 to 15	50	46.0	34.0	18.0	2.0
May 16 to 31	51	41.2	39.2	17.6	2.0
June 1 to 15	71	50.7	26.8	18.3	4.2
June 16 to 30	54	59.2	25.9	12.9	1.9
July 1 to 15	23	26.1	39.1	35.0	0
July 16 to 31	25	68.0	16.0	12.0	4.0
August 1 to 15	32	46.9	31.2	18.8	3.0
August 16 to 31	19	31.6	15.8	41.6	1.0
September 1 or later	14	11.6	17.5	47.1	5.8
Total	397				

The following conclusions may be drawn from these data: The date of seeding varies from very early spring until about the middle of September, the months in which alfalfa is most commonly seeded being May and June, with the latter half of June as the most popular half month. Aside from the fact that the late August and September seedings have been less satisfactory than the earlier seedings, the date of seeding is not of much importance as compared with the preparation of the seed bed and several other factors. On the medium and heavy soil types especially, the early summer seeding may be safely recommended, the chief advantage in seeding at this time being that the seed bed may be more thoroughly prepared and the weeds more thoroughly eradicated than in the earlier seedings, and the alfalfa will make a larger growth and be in a better condition to survive the winter than the late summer or fall seedings.

Fig. IV. A productive field of alfalfa near Holton, Muskegon County.

While the data in Table VII does not indicate strongly any particular date of seeding as best, it is probably true that on light soils where a summer drought is apt to be very serious, the early or middle spring is as favorable a time as any for seeding, providing a fairly favorable seed bed can be prepared.

USE OF NURSE CROP VS. SEEDING ALONE.

A summary of the data on the use of nurse crops in seeding alfalfa is presented in Table X. Fifty-two per cent of the early (spring) seedings, over ninety of the early summer seedings, over eighty-five per cent of the late summer and fall seedings, and seventy-five per cent of all the seedings were made without a nurse crop. A consideration of these facts and the large percentage of the seedings that were successful would indicate that the use of a nurse crop is not an essential factor in the seeding of alfalfa in Michigan. In the seedings made before June 1st, slightly better results have been secured with a nurse crop than without, but in both the early and late summer seedings, much better results have been secured without than with a nurse crop. Oats, barley, wheat, rye and buckwheat were reported as having been used as nurse crops, but no conclusive data can be elaborated in regard to a choice between these.

TABLE X.—INFLUENCE OF NURSE CROP IN SEEDING ALFALFA.

Date of seeding.	Nurse crop or without nurse crop.	Number seedings reported.	Percentage of seedings graded as			
			Good.	Medium.	Poor.	Failure.
Before June 1st.	Nurse crop	103	41.7	37.9	18.4	1.9
	Without nurse crop	113	41.6	23.1	27.4	7.0
June 1st to July 31	Nurse crop	23	39.1	26.0	26.0	9.0
	Without nurse crop	226	43.4	31.4	17.2	4.0
September 1st and later	Nurse crop	13	15.4	15.4	53.8	15.4
	Without nurse crop	78	40.0	26.9	24.3	9.0
Totals	Nurse crop	139	39.0	34.0	23.0	4.3
	Without nurse crop	417	44.3	28.5	21.3	5.8

Under favorable conditions of seeding the use of a nurse crop would not seem to be advisable. The young alfalfa needs no protection from the sun and is more abundantly supplied with moisture and plant food when seeded alone than when seeded with a more vigorous growing plant to compete against it. On very light soils that are apt to be moved by the wind and on steep hillsides that are subject to washing, a nurse crop should of course be used. The nurse crop may also be advisable on fields that are in course of preparation for only a short time and the weeds not thoroughly eradicated. Under these conditions the nurse crop may assist in holding the weeds in check, and may be more easily eradicated and less objectionable generally than the common weeds. Very late seedings that are apt not to be in hardy condition at beginning of winter, may be somewhat protected by the seeding of a nurse crop although it is considered better to seed alone and apply with manure spreader, after a few weeks; a medium coat of well rotted manure to protect the young plants through the winter.

Two of the best crops for use as nurse crops in spring seedings are the fall wheat and rye as the growth is not as vigorous or the alfalfa as thoroughly shaded as with the use of spring grains. Beardless barley is more satisfactory than oats.

The nurse crop should be cut for hay rather than harvested for grain, as in the latter case the alfalfa is apt to remain spindling and tender until the nurse crop is removed, when it is exposed to the sun during the hottest part of the summer and is apt to die out badly.

DRILLING VS. BROADCASTING OF ALFALFA.

Approximately twenty-two per cent of the seedings were made with a drill and the remainder were sown by hand or with a broadcast seeder. In many of the seedings made with the drill, the drill was followed by a harrow or the seed was distributed by the seeder attachment in front of the drill so that they were essentially broadcast seedings. The data on the exact method of seeding is insufficient to justify its presentation in tabular form and the drawing of definite conclusions from the same. It may be said however, that the drilling (dropping the seed through the grain hose) has the advantage over the broadcast method in that practically all of the seed may be placed at the proper depth in the soil and that a somewhat lighter seeding will give equally good results. In a few cases alfalfa has been drilled deeply on heavy soil, followed by heavy rains which has prevented the alfalfa from coming up. On medium or heavy soils the seed should be put in to a depth of about 1 inch and on the light sandy soils, to a depth of 1½ to 2 inches.

RATE OF SEEDING ALFALFA.

Table XI shows the number of seedings which have been made at different rates and the percentage of good, medium and poor seedings and failures in each class. It may be noted from the table that approximately one-half of the seedings were made at the rate of sixteen to twenty pounds per acre, one fourth at thirteen to fifteen pounds per acre and one tenth at ten to twelve pounds per acre, there being very few seedings at less than ten or more than twenty pounds per acre. The average rate per acre was 17.8 pounds.

TABLE XI.—RATE OF SEEDING ALFALFA.

Rates of seeding.	Number of seedings reported.	Percentage of seedings graded as			
		Good.	Medium.	Poor.	Failure.
Less than 10 pounds	16	43.8	37.5	18.8	00
10 to 12 pounds	54	35.2	22.2	37.0	5.5
13 to 15 pounds	136	33.1	39.6	22.1	5.1
16 to 20 pounds	251	43.4	25.9	25.9	4.8
21 to 25 pounds	26	50.0	27.0	19.0	3.8
Over 25 pounds	29	41.3	34.5	17.3	6.9
Total	512	....	....	....	....

The above data does not indicate that the rate of seeding within certain limits is a very important factor in the seeding of alfalfa. A pound of alfalfa seed contains approximately 150,000 seeds so that a seeding of ten pounds per acre is equivalent to thirty four seeds per square foot. It may be readily seen that this application, or even five or six pounds per acre, is sufficient if the seed is good, if it is evenly distributed and if covered to the proper depth on a well prepared seed bed. However, on account of the difficulty of securing conditions that are ideal in all respects, it is doubtless safe as a general recommendation at least, to advise the use of ten or twelve pounds per acre.

TYPES OF ALFALFA.

There are no commercial varieties of alfalfa which would correspond to the different varieties of corn, oats and other cereal crops, the alfalfa being a mixture of several more or less distinct types. These types vary considerably in their habit of growth, production, adaptability, etc., and offer a splendid field for selection. The Experiment station has devoted considerable attention to the breeding of new strains of alfalfa which are better suited to Michigan conditions and this work has progressed far enough to allow a limited distribution of seed (beginning in 1911) of some of the pure strains developed from the more promising of the individual plants in the breeding plots.

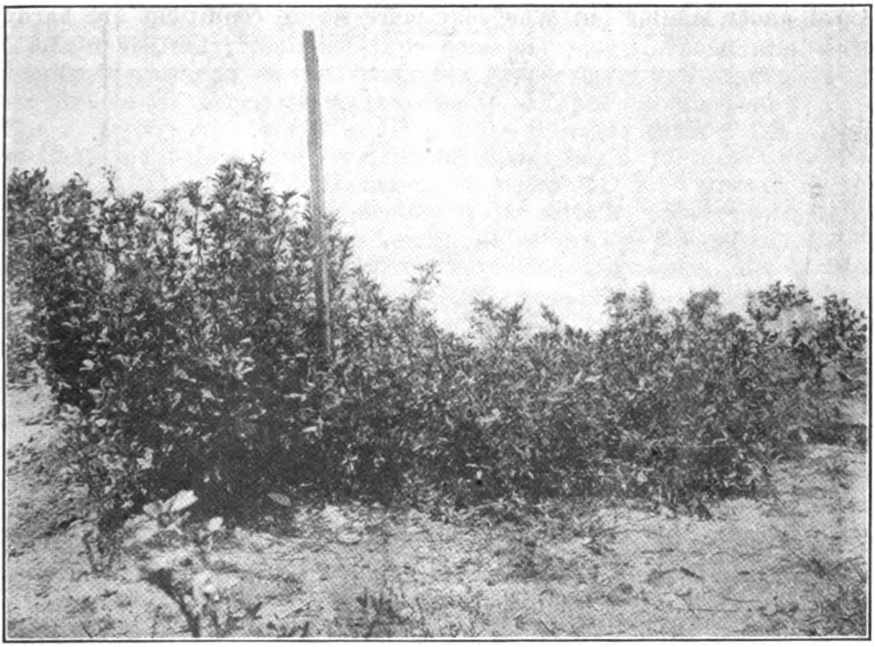

Fig. V. Showing different types of alfalfa. The plant on the left is erect, the one on the right is semi-decum bent.

Alfalfa may conveniently be divided into three types: The Medicago Sativa or common alfalfa which is erect or nearly so, and has a blue flower and spiral shaped pod; the Medicago falcata, which is inclined to be decumbent and has a yellow flower and crescent shaped pod, and the variegated alfalfa, which is supposed to be the result of the crossing of the above two types and which is fairly erect and has a variegated blossom and is intermediate as to form of pod.

The Medicago Sativa is by far the most commonly grown in this country. The Medicago falcata, while possessed of more hardiness than the common alfalfa is not popular for general use because of its decumbent growth and moderate yield. The variegated alfalfa is represented by the Grimm alfalfa, much of the commercial Sand Lucerne and some of the seed from Germany, Canada and other sources. The variegated alfalfa is generally known as a hardy, productive and an all round desirable type, but as it is not generally known among the farmers and as the common alfalfa has given satisfactory results, it is not very generally grown.

There are also many regional types of alfalfa whose characteristics have been acquired by long continued culture under conditions prevailing in certain regions. Examples of these are found in the Arabian alfalfa, the Puruvian, the German and the Turkestan. Many of these are very poorly adapted to growing in the United States; others developed under similar but somewhat more severe conditions are hardy and well adapted to growing here. Conditions governing the production, importation and sale of alfalfa seed, however favor the general use of American grown seed.

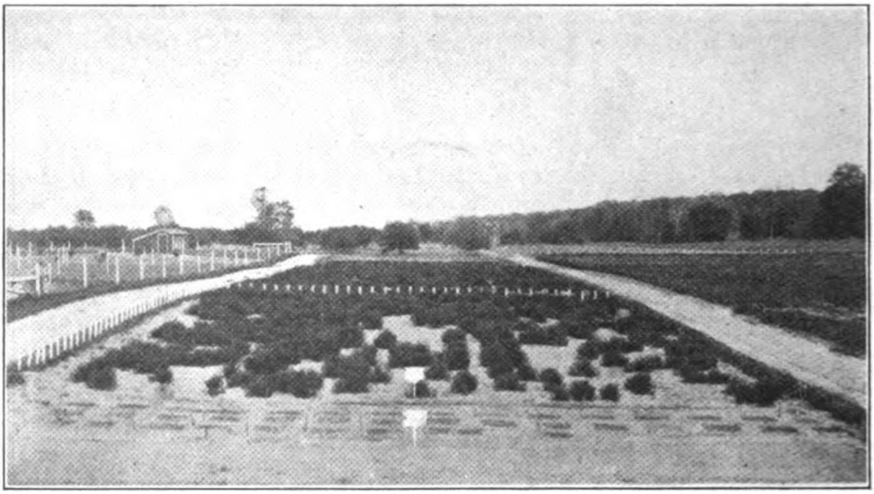

Fig. VI. A view of some of the alfalfa breeding plats at the experiment station.

Approximately 42% of the alfalfa growers reporting, purchased seed which was claimed to have been northern grown and Table XII shows the results with which these seedings were made as compared with those in which the sources of seed was not specified. In many of the latter class, northern grown seed was undoubtedly used.

TABLE XII.

Source of seed.	Number of seedings reported.	Percentage of seedings reported as			
		Good.	Medium.	Poor.	Failure
Northern grown	172	49.4	30.8	16.3	3.5
Source not specified	331	40.8	29.6	23.5	6.1

The above data would seem to indicate that the northern grown seed is better for seeding under Michigan conditions than that grown in the middle and southern states. This is as should be expected, as alfalfa seed is usually produced on fields that are several years old and if grown in the north would come from the more hardy plants which have survived several winters and not from, the less hardy plants which might have survived and produced seed in the southern states. It is recommended that farmers use the northern grown seed whenever obtainable. Seed grown in the Pacific coast states should be avoided because of the presence there of a very serious disease called alfalfa crown gall.

TREATMENT OF ALFALFA FIELDS THE FIRST SEASON.

About the only treatment it is necessary to give to an alfalfa field the first season is to cut it at the proper time and to remove any vegetation which may be so thick as to smother out the young alfalfa. The alfalfa should be cut at the proper time for cutting older stands for hay, or before this time if the leaves begin to turn yellow and fall off. It should also be mown whenever the weed growth becomes so large as to be apt to choke out the alfalfa. The young alfalfa should be cut at the usual height, as otherwise the crowns will be formed high and will be cut off the next time it is mown. Fields seeded in the early spring may need to be cut as many as three times the first season, but in other instances one cutting will be sufficient, as the alfalfa may be injured by too frequent cutting. The last cutting should be made sufficiently early in the fall to allow additional growth, to act as a protection through the winter. Usually alfalfa may be cut safely as late as the first or middle of September.

A top dressing of well rotted manure preferably applied with a manure spreader is of much value in protecting the alfalfa through the winter. It not only acts as a protection from the wind and cold but holds the snow as an additional protection. The heaving out of the young plants by alternate freezing and thawing is worst on very heavy clay soils and is more or less common on light sandy soils but is least serious on well drained loamy soils that contain considerable vegetable matter. The danger of heaving is materially lessened by the top dressing of manure or by leaving some vegetation on the ground.

DISCING OR HARROWING ALFALFA.

The cultivation of the soil after seeding, with a disc or other harrow has been practiced on eleven and one-fourth per cent of the seedings reported, but many of the stands were to young to harrow at the time of making out the reports. In Table XIII is given the data secured from this study.

TABLE XIII.—EFFECT OF DISCING OR HARROWING ALFALFA.

Classification of seedings.	Number.	Percentage.
Harrowed with good results	32	49.2
Harrowed with no apparent effect	10	15.4
Harrowed with poor results	1	1.5
No report on results or too early to tell	22	33.8

The following statements are based on data secured by the Department from various sources. There seems to be no advantage in harrowing alfalfa the first two or three years after seeding, in fact there are many old fields that have never been cultivated which are producing abundantly and are in an ideal condition. The harrowing of old stands that are inclined to be thin may, however, be advantageous because of the destruction of weeds, the aeration of the soil and the creation of a soil mulch to conserve the moisture. Some writers have recommended discing on account of splitting the crowns of the alfalfa, but a careful examination of disced fields fails to reveal any appreciable percentage of split crowns. Fields in which Kentucky blue grass is well established will not be put in a clean condition by cultivation but harrowing will be of considerable benefit in postponing the grassy condition, if done when the grass is just starting in small bunches over the field. The cultivation after seeding then will not take the place of thorough preparation of the seed bed, but will, in many cases at least, result in a larger production and prolong the life of the stand. The proper time to harrow is early in the spring before the new growth starts or immediately after one of the cuttings. The spring tooth harrow is one of the best implements for harrowing alfalfa as it may be used to make a deep mulch and will disturb the alfalfa plants but little. The disc harrow is also a satisfactory implement for this purpose but should be set rather straight and weighted to make it dig properly. An old stand may be harrowed several times, so that the field will have an appearance of a newly prepared seed bed with good results, but the harrowing should all be done at once as nearly as possible and within a few days after cutting.

FUNGOUS DISEASES AND INSECT PESTS.

There are a large number of fungous diseases and insects which work on alfalfa but no attempt will be made in this bulletin to describe and give methods of treatment for all of these. The alfalfa leaf spot and the grasshoppers are mentioned, as these are subjects upon which alfalfa growers frequently request information.

The leaf spot or *Pseudopeziza medicaginis* (Lib) Sacc, is a fungous disease which is very common wherever alfalfa is grown. It may develop under all conditions of soil, season and weather and is present at least to a limited extent in practically all alfalfa fields. It shows the most marked development in moist weather, in the second or third cutting rather than the first, in the older growth more than in the new shoots and in new seedings in which the growth is stunted on account of some unfavorable conditions rather than in the older stands which are making a rapid growth. This disease is characterized by small, brown spots about the size of a pin head which appear on both sides of the leaf and along the stems but are more conspicuous on the upper surfaces. The lower leaves are the first to be attacked. Usually the leaves turn yellow and after a few days begin to fall off.

While this disease is a very common one, it is not considered very serious; it may reduce the yield of a certain cutting but does not usually destroy the stand. Little is known as to the method by which the disease is carried from one field to another and no practical methods have been discovered which will completely eradicate it. Fields that are attacked by leaf spot should be clipped soon after the lower leaves turn yellow and begin to fall off, or when the alfalfa stops growing and the leaves are covered with brown spots, even though little or any of the yellow appearance develops. The cutting of the alfalfa will cause a new growth which will be less affected with the disease than the older growth and usually when conditions are favorable, the new crop will make about the normal growth.

While there are many insects that work on alfalfa, the depredation of the grasshopper is the most serious, especially on the light soil types of the northern part of the state. The new seedings of alfalfa frequently provide a succulent green growth when there is little other green growth in the neighborhood and it is especially subject to attacks of the grasshoppers, an entire field frequently being destroyed in a few days' time.

The following methods of combating grasshoppers are recommended by Professor R. H. Pettit in Michigan Bulletin No. 258.

"Fall plowing.—This is the most efficient where it is possible at all. Plow the egg-pods under, burying some, and breaking open others so that moisture can get in, and exposing still others to the attacks of their enemies,—birds, shrews, etc."

"Poisoned baits.—The second method is that of poisoned baits. Use either poisoned bran or the Criddle mixture. Poisoned bran can be used only in situations where stock and poultry are excluded. Neither should it be used where partridge or quail are likely to feed. It is merely bran poisoned with paris-green or arsenic, two pounds of paris-green to 100 of bran, moistened with water and a little molasses, so that the bran will just stick together when taken up with a spoon."

"Criddle mixture is horse-manure mixed with arsenic and slightly salted. It is to be distributed about the fields in small masses. We all know of the fondness of grasshoppers for anything containing salt. They will even roughen fork handles in their efforts to get at the salt deposited on them with the perspiration. This mixture is recommended in Canada and in some of the western states. The proportions are about as follows: Paris-green, one pound; salt, two pounds, fresh horse-droppings, 100 pounds. The horse-droppings are usually measured out in a three-gallon pail. Five pailfuls being taken as a right amount for one pound of the poison. The salt is dissolved in a pail of water, the poison stirred in, and the whole mixed with the droppings in a half barrel."

WEEDS IN ALFALFA FIELDS.

The worst weeds in alfalfa fields are the perennial grasses, such as Kentucky blue glass (June grass) and quack grass. In some sections of the state the late summer annual grasses such as crab grass, are serious pests. Both of these types of grasses after once being established in the field are very difficult of eradication, the only feasible method of control, especially for the first mentioned type, being a thorough preparation of the seed bed, as previously discussed in this bulletin. When the alfalfa field becomes unproductive because of the foothold gained by Kentucky blue grass or other perennial grasses, it

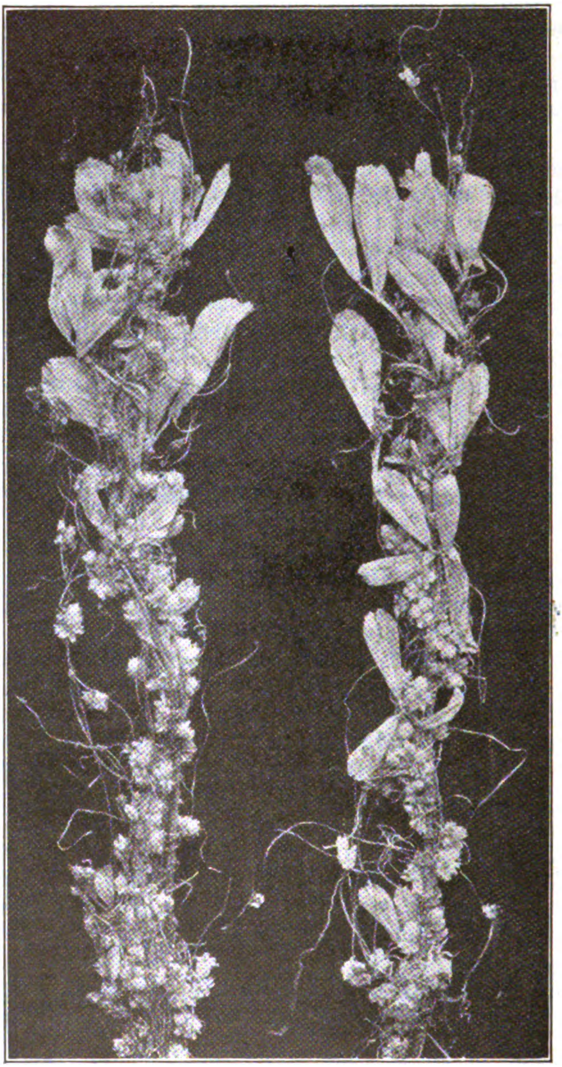

Fig. VII. Dodder growing on alfalfa.

they make a larger growth the first season, which is apt to rob the alfalfa of most of its plant food, water and sunlight and may cause it to die. Usually weeds of this type can be held in check by mowing two or three times during the season. If the alfalfa survives the first is advisable to plow the field and plant to corn or other cultivated crops, and seed alfalfa in another field.

The larger growing annual weeds are not so serious, except that season, it usually makes such rapid growth the second season, that it holds these annual weeds in check.

While the dodder is not common in alfalfa fields, it is considered one of our most objectionable weeds if once introduced on the farm. There are two species which work on the alfalfa, the clover dodder, *Cuscuta epithymum—Murr* and the field dodder, *Cuscuta arvensis—Beyrich.* Both of these species are parasitic plants, the stalks twining about the alfalfa and robbing it of its nourishment by means of little rootlets or suckers which pierce the alfalfa stalks. The plant has no leaves (only small scales). It is usually noticeable because of its whitish flower clusters.

Dodder is usually introduced in alfalfa seed and may be avoided if sufficient attention is given to the purchase of the seed. If the field is not large and there are only a few small spots of dodder, these may be destroyed by hoeing, but should be watched carefully throughout the season to see that more plants do not appear. If the dodder is found to be well scattered over the field, it is best to turn the entire crop under to prevent the formation of any seed. If any seed should be formed, it would not be advisable to attempt the growing of alfalfa in the field for a period of from four to five years.

MAKING ALFALFA HAY.

Alfalfa may be injured by too frequent cutting or if left too long without cutting will not produce the maximum yield or the best quality of hay. The proper time for cutting as determined by experiments in several states and by general experience is when it begins to bloom and the new shoots appear at the crown. Alfalfa growers are frequently inclined to delay cutting on account of unfavorable weather or the rush of other work on the farm, but the above rule should be followed rather closely. If the cutting is much delayed, the new shoots are cut off and the following crop is retarded; the plants become more woody, the leaves begin to drop off and the hay is of much poorer quality than if the crop is cut at the proper time.

In the making of alfalfa hay it is very important that most of the curing be done by the air and wind rather than by the sun. The alfalfa should be left in the swath until wilted but it should be raked before dry enough for any of the leaves to fall off. The curing should then be completed in the windrow and cock. The alfalfa may be put in the cock while still quite green, providing the weather permits it being left for several days until completely cured, the best quality of hay being made in this way. It frequently will be found, however, to be more practical to have the hay fairly well cured before cocking, or even to draw from the windrow. One is certain, however, to sacrifice more or less of the feeding value when the hay is not cocked on account of the loss of the leaves.

The tables below give the analyses of the different parts of the alfalfa plant and the proportion of total feed constituents found in the several parts.

TABLE XIV.—COMPOSITION AND DISTRIBUTION OF NUTRIENTS IN THE DRY SUBSTANCE OF HAY FROM ALFALFA CUT IN EARLY BLOOM—FIRST CUTTING.

Part of plant.	Yield per acre, pounds.	Ash.	Protein.	Fiber.	Nitrogen—free extract.	Fat.
Stalks	28.38	9.01	10.74	42.17	37.14	0.94
Leaves	18.56	14.33	24.05	13.81	41.82	5.99
Flowers	1.36	10.56	26.18	15.58	46.00	1.68
Whole plant	43.31	11.10	16.30	30.53	39.23	2.92

Kansas Bulletin No. 155.

TABLE XV.—PERCENTAGES OF ASH, PROTEIN FIBER, ETC., IN EACH OF THE DIFFERENT PARTS OF THE ALFALFA PLANT, TO TOTAL AMOUNT OF THAT CONSTITUENT IN ENTIRE PLANT—FIRST CUTTING, EARLY BLOOM.

Part of plant.	Yield per cent.	Ash.	Protein.	Fiber.	Nitrogen—free extract.	Fat.
Stalks	58.75	47.69	38.73	81.17	55.68	19.03
Leaves	38.43	49.62	56.74	17.39	41.01	79.34
Flowers	2.82	2.69	4.53	1.44	3.31	1.63

Kansas Bulletin No. 155.

It may be noticed from the above tables that about one-half of the ash, about one-half of the protein and nearly 80 per cent of the fat, the most valuable constituents for feeding, are found in the leaves. The curing of the hay in the cock largely avoids the bleaching by the sun and the exposure to rains and dew. Prof. J. T. Willard, in Kansas Bulletin, No. 155, estimates from data from the Colorado Experiment Station that alfalfa exposed for fifteen days, in which time it was exposed to three rains, amounting to 1.76 inches, lost sixty per cent of the protein, one-third of the fat and forty-one per cent of the nitrogen free extract.

It would seem advisable for the alfalfa grower to provide himself with hay caps, sufficient to cover the hay on a part of his acreage. These should be made of factory, or similar cloth, about six feet square and will cost about fifty or sixty cents each, exclusive of the labor of making. These may be used several times for each cutting.

A word of caution may be in place here against putting the alfalfa in the mow or large stack until thoroughly cured. Loss by spontaneous combustion is much more apt to result from storing uncured alfalfa than in the case of a grass or mixed hay. If the hay is cured in the cock, it goes through a natural process of sweating and usually will be in good condition to go into the mow, but the hay which is cured in the swath and windrow is apt to contain a large amount of moisture in the stalks which make it unsafe to put in the barn.

Many methods of handling and storing alfalfa, such as baling in the field, storing green in open sheds, putting in the silo, etc., are being used or tried in various sections, but the only method that seems to be suited to general recommendation in Michigan is the storing of the cured hay in barns or fairly large stacks. Alfalfa may be made into a fairly good, but rather sour ensilage, but the crop is not sufficiently improved in feeding value to justify this method as a general farm practice. It is questionable even whether the first cutting, which is made at a time when the weather is apt to be unfavorable for curing, may with profit be placed in the silo. However, the last cutting may, to advantage, be mixed with corn, if the weather does not permit it to be made into a good grade of hay. Ensilage made by mixing one load of alfalfa hay with two or three loads of corn would be of higher feeding value than ensilage made from corn alone.

FEEDING VALUE OF ALFALFA HAY.

No attempt will here be made to go into an elaborate discussion of the feeding value of alfalfa hay. In looking over the reports, however, it has been interesting to note that not a single alfalfa grower has any complaint to make in regard to the feeding value of alfalfa hay and practically all who have expressed an opinion consider it very valuable. Of the 97 growers making a comparison with clover, 12.3 per cent consider the hay worth twice as much as clover; 14.4 per cent one and one-half times as much as clover; 5.1 per cent one and one-third times as much as clover; 10.3 per cent one and one-fourth times as much as clover and 50.6 per cent state that it is better than clover. Alfalfa hay appears to have a feeding value above what its composition would indicate, as all kinds of stock do exceptionally well on it. Even hogs, which are not supposed to be able to handle any large quantity of rough feed, do well on alfalfa hay as the main part of the maintenance ration. Because of its high protein content, it is especially valuable as a feed for dairy cows, for breeding animals and for growing young stock. It is of considerable economic value when grown and fed on the farm, as it takes the place of high-priced protein-rich concentrates, such as bran and cotton seed meal, which have of late years entered so largely into the feeding problems in this state. It is more economical under most conditions at least, to feed it as a part ration either with corn or some carbohydrate roughness, as corn stover or grass hay, rather than to feed it alone.

ALFALFA AS A PASTURE CROP.

Two hundred fifteen or about thirty-eight per cent of the alfalfa growers report having used alfalfa for pasture purposes. These tests have been made with all kinds of stock and under various conditions of pasture, season, etc. Twenty per cent of these growers fail to say with what results they have used alfalfa as a pasture crop. The results from the other eighty per cent, who expressed an opinion in regard to this point, are presented in tabular form below.

TABLE XVI.—RESULTS OF PASTURING ALFALFA.

	No. of reports.	Good results, per cent.	Medium results, per cent.	Poor results, per cent.
Horses	19	100.0	0	0
Cattle and sheep	81	90.1	3.7	6.2
Hogs	75	97.3	1.3	1.3
Poultry	2	100.0	0	0
Total	177			

While many of the reports included in the above table are based upon quite limited experience, the data, as a whole, indicates strongly the value of alfalfa as a pasture crop. Practically all of the reports are favorable so far as the effect upon the stock is concerned, only three farmers reporting trouble of bloating of cattle or sheep. Sixteen indicate injury to the stand of alfalfa.

In other states much trouble has been experienced with bloating of cattle and sheep when pastured on alfalfa. The exact conditions which cause this trouble have not been well determined, but the danger appears to be the greatest when the growth is rankest, when no other feed is given to stock, when the stock are turned in when hungry and are allowed to eat all they want when the alfalfa is wet with dew or rain. It is well established that under certain conditions alfalfa is a very dangerous pasture crop for cattle and sheep and farmers are cautioned to exercise much care in turning these classes of stock into a good growth of alfalfa. Little faith should be placed in most of the plans suggested for avoiding this trouble, but the following seem fairly reliable: Sow some grass, preferably orchard grass, with the alfalfa, so that not more than one-half of the herbage will be alfalfa. The stock prefer a variety and will eat the grass with the alfalfa, which will largely, if not entirely do away with the bloating. If late in the season the herbage becomes mostly alfalfa, it is advisable to remove the cattle and sheep from the field.

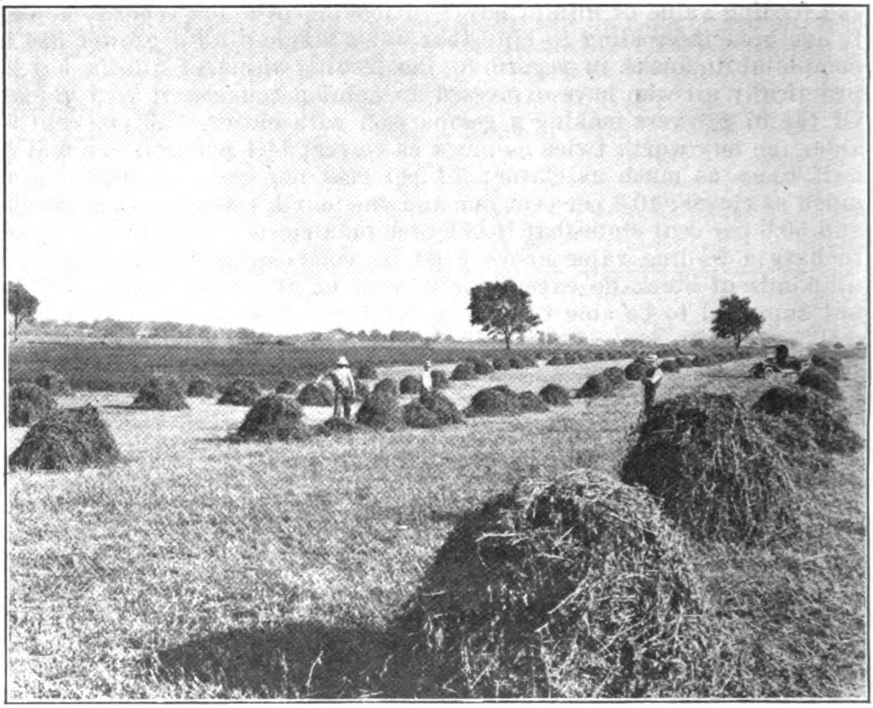

Fig. VIII. A profitable field of alfalfa in Kalamazoo County.

Another method which has been tried with good results is to feed the stock with enough other rough feed before turning into the alfalfa, so that they will eat rather sparingly of the green alfalfa.

Alfalfa makes an ideal pasture crop for hogs and poultry and if properly managed is very satisfactory for horses and mules. Because of its nutritive qualities and the satisfactory growth throughout the entire season, these classes of stock will thrive well on alfalfa pasture and a certain amount of stock can be kept on a much smaller acreage probably, than any other pasture crop suited to Michigan conditions.

The alfalfa pasture should be managed quite differently from the common practice with grass pastures, that is, it should not be kept eaten down closely throughout the season. This will kill many of the plants and present favorable conditions for grasses and other weeds to come in and take possession of the field. The best management, probably, would be to have several lots and to turn enough stock into a lot to eat off the growth in a short time and then to turn the stock into a new field. If only one field is available the alfalfa should be kept from six to ten inches or more high all the time, or if eaten down closely, the stock should be turned out long enough for the alfalfa to make a renewed growth. Alfalfa because it does not propagate vegatively, because it is not inclined to spread over the ground and because it does not thrive continuously under close cropping, is not an ideal pasture plant. It will produce more when cut for hay or soiling than when used as pasture. Still because of its productiveness and nutritive qualities, it ranks well as a pasture crop, especially when mixed with some of the better grasses and clovers and it is recommended that it be generally seeded in this way for pasture, under soil conditions that are favorable for its development.

ALFALFA SEED PRODUCTION.

A very small percentage of the alfalfa growers of the state have attempted to grow alfalfa seed, most of them having been content with the growing of the crop for forage purposes. The success, however, with which the few have grown seed and the amount of seed commonly produced by scattered plants which have not been mown for hay, indicate that Michigan conditions are very favorable for the production of alfalfa seed. The following conditions seem to favor the production of seed; rather dry, sunshiny weather from the beginning of bloom until the maturity of seed; soils that are rather light and of only medium fertility, such as many of our sandy soils; and the thin stands which will allow the wind and sunlight to strike the sides of the plants as well as the tops. If alfalfa is grown primarily for the seed, it should be planted in rows about twenty-eight or thirty inches apart and cultivated. The demand for home grown seed should make this a very profitable enterprise on the lighter types of soils. Profitable crops of alfalfa seed may, however, be produced under certain conditions in the thickly seeded fields. The second crop of the season is the one to save for seed in Michigan, as this allows the cutting of one hay crop and presents more favorable weather conditions for the filling of the seed crop. The third cutting develops too late in the season to mature the maximum amount of seed.

Alfalfa has a long period of bloom and some of the earlier pods mature long before the later pods, so that it is sometimes difficult to determine the best time to harvest the crop. The harvesting should be done at the time that will permit the saving of the largest amount of well matured seed. Usually this is shortly before the earliest pods begin to shatter their seeds and when about one-half to three-fourths of the pods are brown. The harvesting of the seed crop should not differ materially from the harvesting of clover seed, the most important consideration being to handle the crop in such a way as to prevent the shattering of the seed. The cutting should be done when the alfalfa is somewhat toughened by dew. A self-rake reaper or mower with a side delivery attachment should be used to prevent the team from tramping out the seed. The crop should be handled as little as possible and should preferably be stacked before dry enough to lose any seed and be allowed to remain in the stack for several weeks before threshing but may be placed in small bunches while in a tough condition and threshed from the field if the weather is favorable.

PLACE FOR ALFALFA ON THE FARM.

Aside from its value as a soil improver there are three important places that alfalfa may occupy on the Michigan farm, as follows: Seeded alone as a hay crop; seeded alone as a pasture crop for hogs and under certain conditions for other classes of stock, and for mixing with the grasses and clovers for meadows and pastures for all kinds of stock.

Under soil conditions favorable for the growing of this crop, it is generally advisable to use the alfalfa for all three of these purposes. A good stand of alfalfa may be expected to produce more hay than any of the grasses or clovers and the annual risk and expense of seeding is largely done away with. Every general or stock farmer should seed a small acreage near the barn as a pasture for hogs. On many farms a portion of the soil is only fairly well suited to the growing of alfalfa besides some of the grasses should be seeded to produce a hay for the horses and to avoid the danger of bloating when used for pasture, so that it does not seem practicable to devote all of the seeded area of the farm to alfalfa. Even under these conditions alfalfa if seeded with some of the grasses and clovers usually proves to be a very valuable part of the mixture. The seeding alone of a large acreage at the first attempt is not recommended, as the risk of failure in the hands of the inexperienced grower is too great, but the alfalfa seed should be mixed with the regular seeding of clover as suggested above and should also be seeded alone on a small acreage and this increased from year to year until the desired acreage is secured.

Alfalfa is a leguminous plant, and closely related to the clovers, cow peas, beans, etc., and like them is able with the aid of the bacteria which live in the nodules on the roots to take its supply of nitrogen from the atmosphere. It thus improves the soil in the same way clover does. However, after the alfalfa has been seeded in the field for several years and the nitrogen content of the soil increased by the decay of roots, nodules, stubble, leaves, etc., the crop will feed on the nitrates made from this source and will take a smaller percentage of its nitrogen from the atmosphere. The alfalfa then does not do as much to build up the nitrogen content of the soil after it has been grown for several years in a field as it does during the first two or three years after seeding. It is, therefore, not advisable to leave one field seeded for an indefinite period of years, or as long as it produces satisfactorily as is commonly done, but to seed a new field which needs building up and to plow up the old field which should be in condition to produce very satisfactory yields of corn and other crops.

This would necessitate the inclusion of alfalfa in the rotation of crops and bring about other radical changes in the rotations as commonly practiced throughout the state. The rotation of crops suited to a particular farm will depend upon the type of soil and the adaptability of the various crops to the same; the type of farming engaged in; the markets and other local factors. No detailed plans of rotations of crops are presented in this bulletin but the following suggestions are offered as being worthy of consideration: The best plan of carrying out a definite rotation including the alfalfa, is the short rotation of annual crops inside the long or complete rotation, that is, the alfalfa is left seeded in one field for a short period of years and the remainder of the farm devoted to the short rotation. After a few years the old field of alfalfa is plowed up and devoted to the short rotation and alfalfa seeded in a new field.

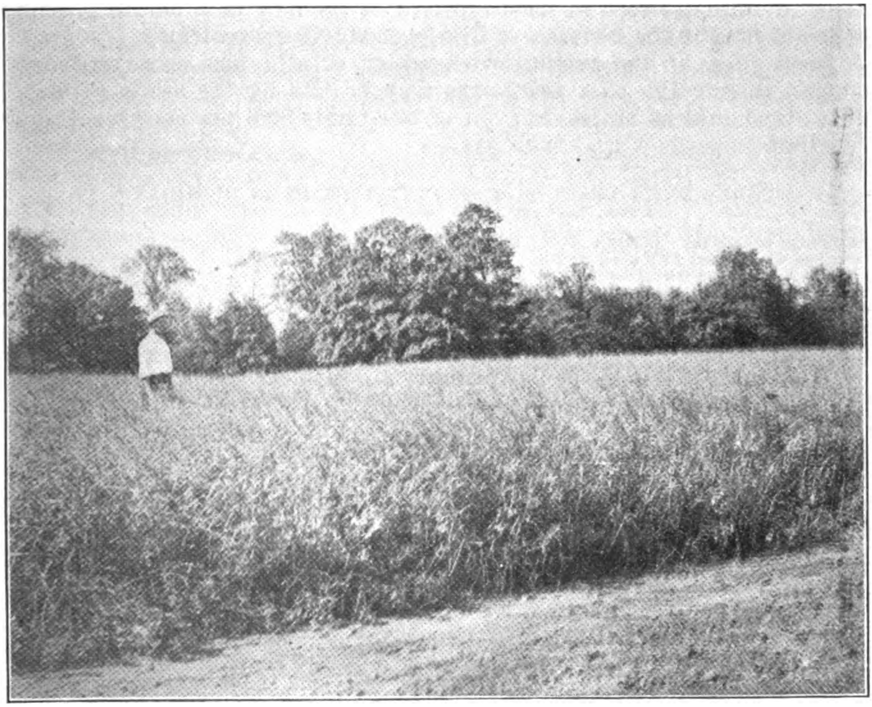

Fig. IX. A field of alfalfa and orchard grass on the college farm, which has produced an average yield of 6 tons per acre during the past 5 years. Orchard grass is one of the best grasses for mixing with alfalfa for pasture or to produce a hay for horses.

The short rotation of annual crops should be one that is favorable to keeping up the fertility of the land. If clover is not needed for the production of hay on account of the alfalfa, it or some other legume should be seeded for plowing under.

The best management probably would be to leave the alfalfa seeded in each field from three to six years. The cost and risk of seeding is materially increased if alfalfa fields are left less than three years and the leaving of a seeding more than six years would not seem to be the most economical use of it as a soil builder for the entire farm, since it would take so long to get the entire farm seeded.

It is advisable to seed at least one-half of the new field before plowing up the old field if the latter is still in a productive condition.

A good idea of the results with which alfalfa has been seeded in Michigan during the past few years may be had by the study of Table XVII. It should be noted that out of 621 trials 85.3 per cent were good or medium.

TABLE XVII.—RESULTS OF SEEDING ALFALFA IN MICHIGAN.

Total number of farmers reports	621
Per centage who seeded with good results	68.8
Percentage who seeded with medium results	16.5
Percentage who seeded with poor results	8.7
Percentage whose seedings resulted in failure	5.9

In Table XVIII is given a summary of farmers' opinions of alfalfa as a farm crop in their respective sections.

TABLE XVIII.—FARMERS OPINIONS OF ALFALFA.

Total number of farmers reports	642
Percentage who have good opinion of alfalfa	77.4
Percentage who have a fair opinion of alfalfa	14.6
Percentage who have a poor opinion of alfalfa	3.7
Percentage who think alfalfa a failure	3.2

The average acreage per field as shown by the reports is approximately six, and the acreage per farm is eight. Many farmers, however, are now seeding much larger fields than formerly, and the above figures will doubtless fail considerably of representing true conditions after one or two more seasons.

As a further indication of the place alfalfa is coming to occupy on the Michigan farm, the following brief statements which are thought to be representative of all of the opinions expressed are submitted.

"I think that alfalfa is worth nearly twice as much per acre as any of our other hay crops."

"It grows better each year. It will stand the grasshoppers, which were very bad this year. It lived while other clover, both new and old seedings, were killed."

"Best paying crop one can raise and also by far the best crop to feed."

"I think in time we can raise alfalfa just as we do clover now, but is slow in starting."

"It is the best paying crop we have."

"Some have been successful and others have failed. If we can get it established, it will be a grand forage crop."

"I think it will be the salvation of the farms in this community."

"Mighty hard work to start, but pays for all expense you can put on it."

"It will solve the problem of loosing the clover seeding, which frequently happens here. I believe in time it will be very commonly grown and will raise the value of any land seeded."

"I believe that it is all right, but it seems to take longer to get a paying stand than clover and therefore, does not work in good in the rotation."

"I think if we can get to growing our own seed nothing can equal it."

"Invaluable! There should be thousands of acres in this country where there is but one grown now. It will revolutionize agriculture."

"I think it will be the most reliable grass crop that we can raise in Southern Michigan."

"A very profitable crop if the farmer will put out only what he can take proper care of."

"A promising crop if the farmer will take pains enough in fitting his ground. I think it is one of the best hay crops Michigan farmers can produce."

"The surest and best hay known. Unexcelled for dairy calves and eaten by all stock readily."

"My intentions are to cut red clover out and make a success of alfalfa."

"I believe it will be a successful crop and the means of making our light land valuable."

"Very valuable to me to cut and feed green, as it furnished feed continuously from May 15 to October 15."

"It will solve the problem of loosing clover seeding."

"It would be a good crop if sown and taken care of on fields where there is good drainage."

"I wish I had fifty acres instead of six."

"A very good pasture for hogs."

"Good, cannot be beat for hay for all stock."

"No better than mammoth clover, of which we can get two cuttings by cutting as first blossoms appear."

"A success on good soil but a failure on poor soil."

"The best hay in the world. Believe it will be a successful crop and the means of making our light land valuable."

"I think it has come to stay. I have twenty-seven acres of alfalfa and expect to have one hundred before long."

"We think it is the making of this part of the country. We expect to get our usual amount of hay off one third the acreage and it is a better grade of hay."

"I think it is one of the greatest crops we can raise as it stands drouth better than other crops."

"For the dairy business of this section it is practically necessary as a hay crop and for keeping down the cost of the dairy output."

"It has not given very good satisfaction in this section."

"It is worth each year the price of the land."

"It is a great yielder of very nutritious hay, which all stock will go to in preference to grain."

"I think alfalfa will grow in any place in the state, seeing that it grew here."

"I have been trying to grow alfalfa for some time but will have to report a failure."

"Alfalfa is a very valuable crop for this section as quite a little stock is kept."

PARTIAL SUMMARY.

1. Alfalfa is rapidly coming into favor as a farm crop in Michigan, ninety-two per cent of the farmers reporting, expressing a good or medium opinion of alfalfa as a farm crop in their respective sections. More successful seedings have probably been made during the past three or four years than in all the previous history of alfalfa in Michigan. Many growers who have been successful in former attempts to grow alfalfa are now seeding much larger acreages.

2. The two principal causes of failure in growing alfalfa have been poor preparation of the seed bed and the lack of inoculation. A decided improvement, however, is noticeable in the cultural methods practiced throughout the state and in practically all the new seedings some means are taken of securing an inoculation of nitrogen fixing bacteria. Among other important causes of failure are acid soils, light infertile soils, poorly drained soils, use of nurse crop and in case of late seedings, winter killing.

3. Alfalfa is being grown successfully on a variety of soil types throughout the state. The particular type of soil does not appear to be of much importance but soils that are shallow by reason of the water table or rock formation near the surface and very light infertile soils should be avoided. Farmers on light sandy soils should seed on their best land and may need to take some special means of building up the fertility of the soil. Farmers in the better agricultural sections should as a rule seed on the higher lands of the farm because this land is most in need of improvement; because the alfalfa as a rule is productive on this land and because the soil most productive with corn and other crops is left for the growing of these crops.

4. Alfalfa should not be seeded after a grass sod but may follow a cultivated or small grain crop. The preparation of the seed bed should be thorough and extend over a period of several weeks, so as to secure a firm and finely pulverized seed bed in which the weeds and weed seeds have been as completely eradicated as possible.

5. The use of manure in seeding alfalfa is advisable if applied some time before seeding or after the alfalfa has come up and made some little growth. It is not advisable to turn under a heavy application in a quickly prepared seed bed as this tends to hold up the soil and allow it to dry out, or to apply as a top dressing shortly before seeding, because of the introduction of the weed seeds.

6. There are doubtless many conditions under which commercial fertilizers judiciously applied, may profitably be used to stimulate a more vigorous growth both in the new and old seedings but the idea that is more or less prevalent that commercial fertilizers may be used to immediately make any soil productive is a fallacy, and until further data is available at least, commercial fertilizers should be applied in an experimental way to learn what may best be used under local conditions.

7. On many soils throughout the state lime does not seem to be needed but on others it is quite essential to the successful growing of alfalfa. It is well to apply lime on a portion of the field when seeding alfalfa for the first time, especially if difficulty has been experienced in growing clover, or if there is any other indication of an acid soil.

8. The presence of nitrogen fixing bacteria is of utmost importance in the growing of alfalfa. Both the soil and pure culture methods of inoculation have given good results and one or both should always be used whenever alfalfa is being seeded for the first time in a field.

9. The exact date of seeding is not of so much importance as the preparation of a good seed bed and several other factors. Late spring or early summer is a favorable time on the medium or heavy types of soils, and early or middle spring is a good time on the lighter types of soils.

10. The use of a nurse crop is not advisable except on fields that are apt to blow or wash and on seed beds that are poorly prepared and are apt to become very weedy.

11. If a drill is used judiciously this method of seeding is preferable to broadcasting and harrowing in but care should be exercised to see that the seed is covered to the proper depth.

12. The rate of seeding within certain limits is not an important factor in the seeding of alfalfa. A very light seeding is satisfactory under ideal conditions. Ten or twelve pounds per acre should ordinarily be as good as more and is a safe amount for general recommendation.

13. There are no commercial varieties of alfalfa in the sense that we have varieties of corn, wheat, etc. For general use we must depend mainly upon the American grown seed of the common or the blue flowered alfalfa, though the Grimm and other selections of the variegated alfalfa are very desirable for planting under Michigan conditions. Northern grown seed should be purchased in preference to that grown in the central and southern states.

14. New seedings of alfalfa should be clipped often enough to hold the weeds in check but not usually more than two or three times during the first season.

15. The harrowing of alfalfa during the first two or three years after seeding is not advisable. Old stands that are thin and weedy are frequently improved by this treatment.

16. The alfalfa leaf spot is a more or less common disease of alfalfa but is not usually considered serious. Fields that are badly affected should be mown, when if the weather conditions are favorable the alfalfa will usually make its normal growth.

17. Much care should be exercised in the purchase of seed to avoid the introduction of noxious weed seeds on the farm. If dodder is introduced it should be thoroughly eradicated before it goes to seed even at the expense of destroying the stand of alfalfa.

18. The better methods of making alfalfa hay are quite different from those commonly practiced in the curing of mixed hay and should be given considerable study on the part of the inexperienced alfalfa grower.

19. Alfalfa hay is considered generally to be of very high feeding value. Of those growers making a comparison with clover hay 92.7 per cent consider it better than clover.

20. Alfalfa is not well suited to stand close cropping and the tramp-

ing of stock but still is a most valuable pasture for hogs and under certain conditions and treatments for other classes of stock.

21. Little alfalfa seed has yet been produced in Michigan but there is promise that a seed industry of considerable importance may be developed in the state on account of the adaptability of many of our soils to alfalfa seed production.

22. Alfalfa should be seeded on practically every farm, all or a portion of which is well drained, throughout the agricultural sections of the state. Its special places in Michigan agriculture are, seeded alone as a hay crop, seeded alone as a pasture for hogs, and as a perennial legume for mixing with clovers and grasses for both hay and pasture.

23. It is not advisable to seed a large acreage of alfalfa at the first attempt. A small acreage should be seeded under as favorable conditions as possible and this increased after some experience has been gained in growing this crop.

24. The profit from the entire farm will be increased if alfalfa is reseeded in a new field every four to six years as compared with leaving the same field seeded for any definite period. The best plan for a rotation of crops including alfalfa is the short rotation of the annual crops inside the long or complete rotation.

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